Painted by H A … ay

MICHAEL FARADAY D.C.L. F.R.S.

THE
YEAR-BOOK OF FACTS
IN
Science and Art:

EXHIBITING

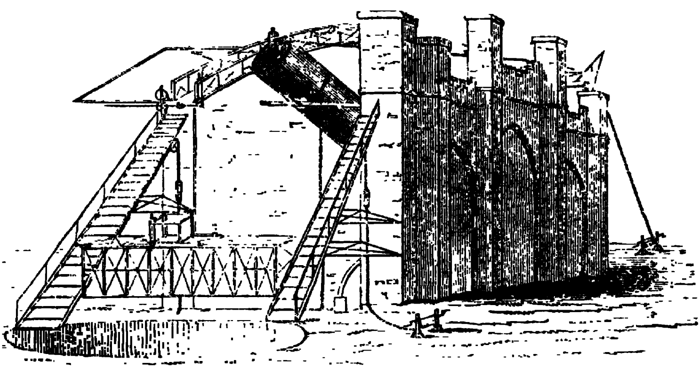
THE MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS OF THE PAST YEAR,

IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND GEOGRAPHY; METEOROLOGY AND ASTRONOMY.,

Illustrated with Engravings.

BY THE EDITOR OF "THE ARCANA OF SCIENCE."

"The history of all Science shows that minute Facts were first observed, and elementary principles first established; but its progress has been from strength to strength, and the advancement has been accelerated by co-operation and the sympathetic activity of all intelligent men. This augmentation has brought a rich reward; for every page adds to the great record of knowledge, and registers for mankind one of the eternal laws which the wise Creator has framed for the government of the Universe."—THE EARL OF ROSSE: PROC. BRITISH ASSOCIATION, 1844.



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HENRY SASS, artist.
WILLIAM GRIEVE, scene-painter.
JACOB SAMUDA, engineer.

WILLIAM WALLACE, LL.D. late Professor of Mathematics in the University of Edinburgh. (April 1843).

THE

YEAR-BOOK OF FACT[illegible]

Mechanical and Useful Arts.

WARNER'S EXPLOSIVE FORCE.

ONE of the most popular scientific displays of the pa[illegible] exhibition off Brighton, on Saturday, July 20th, by Mr. [illegible]ner, of the effects of an Explosive Agent, which he pr[illegible] have completely under his control. The experimentalist has been, for some years, engaged in researches on the force and applicability of explosive compounds to the purposes of marine warfare. At length, he undertook to prove that no ship could chase a vessel furnished with his materials of destruction, without herself being destroyed: after all attempts had failed to arrange an experiment on a large scale, at the expense of the Government, the friends of Mr. Warner determined to test his invention at their own cost; and Mr. Somes, the ship-owner, having, for this purpose, generously presented the *John o'Gaunt*, a barque of 300 tons measurement, the experiment took place on the day above mentioned, in the presence of thousands, many of whom were persons of influence, who had gone to Brighton for the purpose of witnessing the experiment.

The detailed reports on the subject have been so prominent in the public journals, that we shall not recapitulate the circumstances, but merely relate the certain results, which may be thus briefly stated. The John o'Gaunt was towed out to the destined scene of operation about one mile and a half from the shore, and 300 yards in the wake of the Sir William Wallace, on board of which vessel was Captain Warner. The signal for the destruction of the vessel was made from the shore; and within five minutes, " the instrument of destruction, whatever it was, seemed to strike the vessel midships, for, from that point a huge column of water, in which was intermingled some of the shingle of which her ballast was composed, shot up perpendicularly into the air higher than her highest topmast; her mizen went by the board, her mainmast, a new one, was shot clean out of her like a rocket; she heeled over to port to an angle of 45 degrees, and her main hatchway being open, daylight was visible through her bottom timbers on her starboard side, and probably her larboard also, having been blown away; and she seemed to part asunder as she went down, leaving nothing perceptible but the top of her foremast. The time which passed from her being struck and her sinking could not have exceeded two minutes and a half."

It is right to state that the above experiment was in order to show the portions of the invention which may be applied at sea, in the blockade of towns, or defence of places from attack by sea. There is

another application of the power, which is intended for a long range in the destruction of forts and places of strength.

From among the many discussions on the subject, we select the following, in No. 19 of the *Artizan:*

"Mr. Warner professes to have discovered, or invented, an explosive force far superior in destructive agency to any hitherto known. He also professes to possess the means of controlling this force, so as to render its application safe to the operator, and certain in its effects. In applying it, he adopts two means; one of which is to be employed in defence, the other is more especially adapted for attack. It is the defensive system he has hitherto exhibited, and it is to be regretted he should have selected that means of operating, as it is by far less satisfactory and less novel than the other means of destruction which he states to be at his command. The experiment off Brighton, indeed, we consider completely failed to prove the invention to possess any remarkable and hitherto unknown power of destruction. There were no sufficient precautions taken to prevent any trick, if any such had been attempted; and, though we have no suspicion of the kind, yet those who have would certainly not be convinced to the contrary by the Brighton experiment. The signal given from the battery for Mr. Warner to commence operations was intended to remove all suspicion of previous arrangement for setting fire to a fuse connected with combustibles on board; but so long a time elapsed between giving the signal and the destruction of the ship that, as a precautionary measure against deception, it was altogether nugatory. The proposed mode of operating, indeed, was not such as to raise public estimation of the application of the new power. The shell containing the destructive compound was to be dropped into the sea from the steamboat on board of which Mr. Warner was, and the ship to be destroyed was to be towed over the shell by the steamer, the explosion being caused in some manner by the ship itself. By some contrivance, the shell, which is buoyed up so as to float a little below the surface of the water, is attracted or drawn to the hull of the vessel, and explodes at the same instant. The smothered sound of the explosion proved that it took place under water. Its force took effect between the main and mizen masts, both of which were snapped off, and were thrown into the air; a large volume of white smoke or vapour issued from the larboard side of the ship, and for a time enveloped it. The injury done below the water-line soon caused her to fill, and she sank within two minutes after the explosion. The foremast remained standing, and apparently uninjured.

"In such an application of the power, it would be mainly serviceable to a ship that was chased, or in blockading or protecting a harbour. If submarine traps can thus be laid unperceived, the dangers of navigation would be greatly increased, for it is probable that a chased ship would be obliged to drop several shells before the chaser came within the range of any one, and the remaining explosive traps would be more dangerous than sunken rocks. But, it is needless to anticipate dangers that may, perhaps, be easily remedied. The question is, does the invention of Mr. Warner, as shown in the destruction of the ship off Brighton, present anything in its mode of operation, or in its effects, greatly differing from previous inventions? In our opinion it does not.

"We do not mention these circumstances with a view to underrate Mr. Warner's invention, but to show that its efficacy has not yet been proved, and that if, as he asserts, he possess the power of propelling his shells a distance of six miles with unerring certainty, it is greatly to be regretted he did not exhibit that power instead of performing an experiment which might have been as effectively accomplished by known means."

Such of our readers as wish to see the experiment in its several stages, are referred to the *Illustrated London News* for July 27, 1844, wherein are six engravings of the results, from sketches by Mr. N. M. Condy, the marine artist, who witnessed the entire experiment.

Mr. Warner appears to have first described his new implement of destruction to King William IV. in 1831, when his Majesty directed

its merits to be investigated; and, accordingly, Admirals Sir Richard Keats and Sir Thomas Hardy reported thereon, satisfactorily.* Subsequently, at the request of Lord Melbourne's private secretary, Lieut. Webster examined the principle and practice of Mr. Warner's discovery, and, in 1839, asserted its merits to be "so extraordinary as to vest the absolute sovereignty of the seas in the hands of the first power that should adopt them." Their range was stated at five or six miles; and a hundred sail of the line were declared to be useless against a vessel furnished with this stupendous power. Nevertheless, the subject rested until 1840, when it was agitated in the *Times*. In the spring of 1841, a trial took place upon a lake, in Essex, in the presence of Sir Robert Peel, Sir G. Murray, Sir H. Hardinge, Sir F. Burdett, Lord Ingestre, Col. Gurwood, and Captains Britten and Webster; when, with a shell weighing only 18lbs. was lifted into the air, a boat weighing 2½ tons, filled in with 5½ tons of solid timber; it was shattered into a thousand pieces, and at least 14 or 15 tons of water were displaced; the noise of the explosion scarcely exceeding that of a gun. A commission had previously been appointed by government to investigate the merits of Capt. Warner's discovery; and the results were embodied in a pamphlet by Mr. Walesby, the barrister. Still the question was left undecided until the recent experiment at Brighton.*

PROBABLE MODE OF CONSTRUCTING THE PYRAMIDS OF EYGPT.

MR. PERIGAL has read to the British Association†, the description of a (supposed Egyptian) mode of raising very large stones, such as he imagines to have been practised by the Egyptians in the erection of their pyramids and temples. Mr. Perigal having in vain attempted to discover in what manner the prodigious blocks, (such as those of the Pyramids of Gizeh,) could have been elevated from step to step, merely by the aid of short pieces of wood, (referred to by Herodotus,) the idea occurred to the author of this paper that they might have been raised by some such system as the following process:

Each block of stone, shaped and prepared for use before it left the quarry, was conveyed across the Nile (advantage being taken of the periodical inundations) on rafts, or other appropriate vessels, to the causeway described by Herodotus; along which it was dragged on rollers, or on sledges if the stone was smoothed or polished, by the labour of men (or of cattle), to a convenient locality adjoining the Pyramid, where it remained till wanted; thence it was conducted to the first step of the pyramid on rollers. To get the rollers underneath, wedges were used, if it lay on the hard rock; otherwise the earth was removed from beneath one half of the stone, the director or superintendent having placed himself upon the further end to prevent it from tilting over too soon.

Next, the director having walked on the top to the other end, the stone (overbalanced by the leverage of his weight) tilted into the hollow in the ground, when rollers were placed under the other half of it.

The director having walked back again, the stone was tilted on to the rollers,

* The Experiment in 1841 will be found fully reported in the *Year-Book of Facts*, 1842, p. 39-41. Mr. Walesby's Pamphlet, (3d Edition), we believe to be out of print.

† At the (second) Meeting at York, Sept. 27, 1844.

and conveyed to its destination at the foot of the Pyramid; where, perhaps, it was transferred in a similar way to larger rollers.

Then commenced the lifting process. All but one roller being removed, that one being as nearly as possible under the centre of gravity, the stone was tilted as before, while flat boards or planks were placed beneath; and upon these boards another, very much narrower, to act as a fulcrum, all being about the same length, proportioned to the width of the stone.

The director having walked to the other end, the stone was tilted on to the boards, and similar planks were piled beneath by the side or parallel to the others, but a degree higher or more in number; and upon them also a narrow fulcrum-slip, upon which the stone was then tilted.

The director having repeatedly walked backwards and forwards, tilting each end of the stone alternately, and additional boards having been introduced every time, the stone gradually rose to the required height, rather exceeding that of the next step, when rollers were placed on the boards and the stone was transferred to similar planks placed in readiness on the next step of the Pyramid.

The same process was then renewed, and continued from step to step till it arrived at its destined locality.

"Thus," adds Mr. Perigal, "the properties of the lever and of the centre of gravity were brought into co-operation, so that *the weight to be lifted was itself the principal element of the lifting power.*" Figuratively speaking, THE STONE WAS MADE TO RAISE ITSELF BY MEANS OF ITS OWN WEIGHT.

Mr. Perigal's discovery of this method of raising heavy weights had, however, been anticipated by Lieut. Col. Daunsey, of the Royal Artillery; and was partially adopted in 1834, in the removal of "Young Memnon," at the British Museum. "Consequently," observes Mr. Perigal, "no doubt need be entertained of its being practicable. The question for discussion, therefore, is, whether such a plan was actually practised by the Egyptians in constructing the Pyramids, &c."

NEW STEAM VESSELS.

THE following are the most important novelties of the past year:—

The City of London, a new iron steamer, built by Mr. Robert Napier, of Glasgow, to trade between Aberdeen and London; and she does equal credit to the spirit of her owners and the skill of her constructor. She is, without exception, the handsomest iron steamer of the sea-going class we have ever seen; not merely in the beauty of her shape, but in the careful and workmanlike manner in which the vessel is put together, and the nice finish and skilful adaptation of each part to its proper functions. The plan of the boilers is, in our judgment, a very excellent one,—heavier, it is true, than the tubular boilers, but less experimental. The hanging water-bridges at the extremity of the furnaces are an excellent expedient.

Dimensions.—Length over all, 230 feet; length of keel, 195 feet; breadth of beam, 31 feet; breadth over all, 53 feet; depth of hold, 19 feet, 4 inches. The keel, a bar of iron, 6 inches deep, by 3 thick, scarphed sideways at the joints, and riveted through; garboard streak $\frac{3}{4}$ inch thick; bottom plating, $\frac{11}{16}$ in. thick; plating, from round of bulge up to 15 ft. water line, $\frac{1}{2}$ in. thick; plating of top sides, $\frac{3}{8}$ in. thick; frames, angle iron, 5 ft. by 3, and 1 foot apart; floors, 20 inches deep, straight on their upper sides, and terminating at the

round of the bilge; the floors are of $\frac{3}{8}$ in. plate, and have an angle iron both at their superior and inferior edges, which join together where the floors terminate, and the upper angle iron runs 6 feet up the side, affording an attachment to an internal bilge plate. There is no ceiling, nor diagonal trussing amidships, which we think a defect. There are four water-tight bulkheads, the rivets securing which to the sides, and also those of the frames, are 8 inches apart, so as not to weaken the ship by a vertical row of close rivet holes. A waterway plate, of 30 in. by $\frac{7}{16}$ thick, runs right round the ship; paddle beams, a box of plate iron, 22 in. by 22$\frac{1}{2}$ in. thick. Main deck beams, T iron, 14 in. deep; keelsons for engines, iron boxes, 14 in. wide, and the top of the inner keelsons ranging 4 feet from the bottom plating.

The engines are on the side lever plan, but very compact, and with malleable iron framing; the diameter of cylinder is 71 in., and the length of the stroke 6 ft. 6 in.—*Artizan*, No. 19.

The Liverpool Screw is an iron vessel of 65 ft. long, 12$\frac{1}{2}$ ft. beam, and 3 ft. 9 in. draught of water. The vessel is propelled by two high-pressure oscillating engines, with cylinders 13 in. diameter, and 18 in. stroke. In some experiments, the pressure of the steam in the boiler varied from 50 to 60 lbs. per square inch, and was cut off at one-fourth of the length of the stroke, working the remainder by expansion; the nominal power was 20 horses, but it did not really exceed 18$\frac{1}{2}$ horses. The cylinders were placed diagonally, with both the piston-rods working upon the same crank, the driving shaft being beneath the cylinders and running directly to the propeller without the intervention of either geering or bands. The screw-propeller was enlarged three times, and at last was left at 5 ft. 4 in. diameter by 20 in. in length; it was set out with a pitch expanding from 10 to 11 feet, on Woodcroft's plan; it was made of wrought iron, with four short arms with broad shovel-ends, whose united area was 16 square feet, 13 feet only of it being immersed, as some portion of the arms was constantly above the water; the angle of the centre of the float was 45°; the speed of the propeller was generally 95 revolutions per minute. With these dimensions, the speed attained was described at 10$\frac{1}{2}$ statute miles per hour. The amount of slip of the screw in the water as ascertained by Massey's log was stated not to exceed 5 per cent. Several experiments showed that there was not more tendency to "list," or to turn round by the action of the screw, than with paddle-wheels; and the vessel was said to have excelled all the other steamers in the port of Liverpool in towing out vessels in a rough sea.—*Glasgow Practical Mechanic*.

The Water Lily, an iron schooner, of about 170 tons, has been built by Messrs. Ditchburn and Mare, and engine fitted by Messrs. Maudslay, Sons, and Field. The engines are of the direct action, low pressure class, with 14 inches stroke: and the screw is of the common sort, 8 feet diameter, and 16 feet pitch. The vessel has a double rudder on the plan patented by Mr. Joseph Maudslay, which has enabled the constructors to fix the screw abaft of the stern-post outside

of all, whereby the tremulous motion observed when the rudder is immediately in the rear of the screw, is avoided, and perhaps also something gained in point of diminution of resistance. In a trial, she has realized a speed of nearly thirteen miles an hour, which exceeds by more than a mile the greatest speed attained in the course of the Government experiments.—*Mechanics' Magazine.*

The Princess Mary has been built for the South Eastern Railway Company, by Ditchburn and Mare, and fitted with annular cylinder engines, on the patent plan of Mr. Joseph Maudslay, constructed by the firm of Messrs. Maudslay, Sons, and Field.

The Princess Mary is 143 feet long, and 20½ feet broad; her draft of water is 6 ft. 3 in., being built expressly for a sea boat, and to take the ground in Boulogne and Folkestone harbours. The engines are of the collective power of 120 horses; the boilers tubular; and the wheels of the same feathering description as those fitted to the *Princess Alice.*

The Meteor is a beautiful boat; she is as slight, both in form and construction, as it is possible for a boat to be, even to navigate the smooth waters of the Thames. She is worked with rather high pressure, and would have most probably attained a greater speed if she had not unfortunately been fitted with beam-engines. She has had several trials with the *Prince of Wales* and *Isle of Thanet*, which she has beaten, and with the *Sapphire*, which she has nearly equalled. The latter (the *Princess Mary*) has most of the qualities essential in swift boats—*Mechanics' Magazine.*

The Terrible has been constructed in the Royal Dockyard, at Deptford, and is stated to be the largest steam-frigate in the world. Her main dimensions are:—Length between perpendiculars, 226 ft.; keel for tonnage, 196 ft. 10¼ in.; extreme breadth, 42 ft.; depth of hold, 27 ft.; engine-room, length, 75 ft., width 38 ft., depth, 27 ft.; diameter of paddle-wheels, 34 ft. by 13 ft.; diameter of cylinder, 6 ft.; power of engines, 800 horse; weight of engines, 500 tons; coal boxes to hold 800 tons of coals; burthen 1847 tons; cost of boilers and engines complete, £40,250.

H.M. Steam Frigate Janus is a novelty in its way—like nothing else afloat; bow-shaped at both ends, so that if it cannot advance, it may move in the opposite direction; double ruddered, has two capstans, two pairs of hawser-holes, all to match; and is filled with rotatory engines. The whole design, vessel and engines, is that of the Earl of Dundonald, better known in naval history as the brave Lord Cochrane. The double-bow principle seems to us doubtful, in as far as speed is concerned, and also as far as trim of the vessel is concerned, if it be really intended that it shall sail with equal facility in both directions: it is at least not the form of least resistance, and there is little probability that the trim which suits best for motion in one direction, will not be the most answerable trim for sailing in the opposite direction. The rotatory system of engine is also rendered doubtful by experience,

for although strictly correct in principle, there are mechanical objections to it which we hardly think his lordship's mode of construction, even with the lately patented improvements, fully proves. His recent patent for a mode of packing, however, certainly goes far towards accomplishing the object contemplated.—*Glasgow Practical Mechanic.*

The *Gladiator* steam-frigate is fitted with engines by Messrs. Miller, Ravenhill, and Co. They are of 430-horse power, and have been constructed on the plan for which Mr. Miller has a patent. The cylinders are 78½ inches in diameter, and 5 feet 9 inches stroke; they are furnished with Howard's patent condensers. The air-pumps are placed in an inclined position between the cylinders, in the central line of the vessel in a fore and aft direction—an arrangement which is of marked advantage in sharp vessels, and in war steamers, where deck-room and coal space between the ship's sides is important, as it enables the engineers to place the cylinders nearer to each other, and at the same time lower down in the vessel. The *Black Eagle's* pumps are arranged in the same manner; as are those of some of the Watermen's boats of late date. Ordinary or side-lever engines, of the power of those made for the *Gladiator*, would occupy 27 feet of the length of the vessel, in its best part, and weigh, at the lightest, with common boilers, and water in them, from 430 to 440 tons. But the engines of the *Gladiator* occupy only from 18 to 20 feet of the length of the vessel, and, with tubular boilers, water included, no more than 275 tons.—*Mechanics' Magazine.*

Atmospheric Steamer—The Wonder has been completed by Messrs. Seaward and Capel for the South Western Steam Navigation Company, and is intended for the Southampton and Havre station. Her length between perpendiculars is 160 feet; breadth of beam, 22; depth of hold, 12 feet 9 in.; draught when light, 5 ft. 6 in.; and when loaded, 6 ft. 6 in. Her machinery is similar to that of the well-known fast-goer the *Sapphire*, constructed on the same principle; there are three open-topped cylinders provided with expansion valves, each cylinder being 53 inches in diameter, with 3 ft. 6 in. stroke. The nominal power of the engines is 130 h. p.; but the real power must be nearer 200. The boilers are tubular and two-storied. The paddle-wheels are of the vibrating class, on a plan which is a modification or improvement of Morgan's and Cavé's. Each wheel is 20 feet in diameter, and has 12 floats, with a surface each of 20 square feet.

The Prince of Wales is an iron vessel built by Messrs. Miller, Ravenhill, and Co., the well known engineers, who also constructed the engines, which were originally a pair of side lever engines, taken out of another Margate steamer. During an experimental trip, the *Prince* made several trials in Long Reach, to test her capabilities as to speed, which may be calculated at not less than 12½ knots through the water. She ran down below the Nore, and could find no competitor with whom to try her comparative speed; on her return she again tried

her speed at the mile distance in Long Reach when she met the renowned Princess Alice. The helm of the Prince was ordered to be brought about, but before the vessel was fairly turned, her sister, the *Princess*, had got a-head a full mile; nothing daunted, the *Prince* moved on, and in about 30 minutes he went right a-head of her. All on board of the *Prince* pronounced it a decided victory of at least one-and-a-half to two miles per hour faster than the *Princess*; we may, therefore, (March 26), pronounce, without fear of contradiction, that the *Prince* is the champion of the river. This we must own was to us a fine trial: here we had the skill of one of the first builders of iron vessels, Messrs. Ditchburn and Mair, with the annular engines of Messrs. Maudslays and Field, against the iron steam vessel and engines of the *Prince of Wales*, both constructed by Messrs. Miller, Ravenhill, and Co.

The *Gipsy Queen*, said to be the largest iron steamer ever built on the river Thames, has been also launched from a new yard established by the Messrs. Samuda, at Orchard Place, Blackwall. Her length, from the figure-head to the taffrail, is 197 feet 6 inches, and between perpendiculars 175 feet; her breadth between the paddle-boxes is 24 feet. Her burden is 496 tons. Her engines, which are on a new plan, patented by Messrs. Samuda, are of 240 horses' power. They are placed fore and aft, and not, as the engines of most steam-vessels are, on each side of the keel; the cylinders are directly over the keel, and being in one frame-work, all strain will be avoided on any part of the vessel; their total weight, including boilers, &c. which are tubular, water, and paddle-wheels, is only 87 tons. The form of the steamer is well calculated for speed. She has a considerable rise of floor, and for a sea-going vessel (she is built for the Waterford Steam-packet Company, and will travel between London and Waterford) her lines are remarkably fine.—We regret to add that a distressingly fatal accident, involving the death of nine persons, occurred on board this steamer, off Blackwall pier, on Nov. 12th. At the inquest held upon the sufferers, the cause of the accident was stated to be the giving way of the joints of a large steam-pipe connecting the boilers with the cylinders of the machinery. One of the joints is called a "flange" joint, the two ends of pipe to be joined being flattened out to a much larger diameter, and the flattened surfaces rivetted together. This joint is as strong, or stronger, than the pipe, but will not yield to any vibration, and is therefore not so well calculated for steam-engines. Another joint is called a "stuffing-box," in which one pipe is made to slide into the end of the other, which is made larger to receive it, the edge of the recipient pipe being then riveted to a collar on the inserted pipe. This joint is also quite safe, and yields a little to any vibration of the engine. The remaining joint, which was the one used to connect the boiler with the machinery of the Gipsy Queen, is called a "spigot and faucet" joint, in which the end of one pipe is simply inserted a few inches into the end of the other, without any fastening whatever beyond a packing of hemp to keep it tight. The pipe connecting the boilers with the machinery was of considerable

length, having two of the "spigot and faucet" joints in it, one about the middle, and the other after a sharp bend of the pipe, where it was inserted to the side of the cylinder. It appears that the joint so made had resisted a pressure of steam of 10lb. to the square inch; but on the vessel stopping, Mr. Samuda was anxious to see a pressure of 25 lb. to the square inch to test the valve, the boiler being calculated to bear 40 lb. pressure to the square inch; and with this object he directed the steam not to blown off till a pressure of about 25 lb. to the square inch was attained. His directions were attended to; and it appears from the evidence that on this pressure being applied, both the "spigot and faucet" joints gave way, the spigot pipe at the joint at the cylinder being forced out of its socket entirely, and the pipe at the elbow bend turned round the other end of this pipe, which also formed a "spigot," at its junction with the pipe to the boiler being also forced out of the "faucet," the whole piece of pipe being disconnected, and hanging in the slings which supported it. The steam thus escaped direct from the boiler through the severed pipe, which is about ten inches in diameter, with immense force, and scalded and suffocated to death all who happened to be within its reach. Mr. Jacob Samuda was immediately under the middle joint of the pipe, which was only about a foot above his head when it gave way.

French Iron Screw Steamer.—Mr. Cavé has completed a pair of 150-horse oscillating engines, or the two equal to 300-horse power, for an iron steam-vessel, which he has likewise built for the French Government in Senegal; it is to be propelled by a screw made entirely of wrought iron, galvanized and coated with a peculiar varnish to prevent its corrosion by salt water. By a very simple contrivance for which Mr. Cavé has taken out a patent in France, the screw can at all times be disengaged from the gearing, and brought upon deck, so that the speed of the vessel may not be impeded by it when there is a sufficiency of wind to use sails without steam. Before Mr. Cavé decided on adopting any peculiar sort of screw, he caused an iron steam-boat, with a steam engine of the power of 20 horses, to be tried up the river Seine, to be propelled by at least 20 different shaped screws, till at last he found one more effective than the other, which he adopted for the vessel.

The Princeton, with Ericsson's Transversal Screw Propeller.—This vessel is described in the *New York Herald* as a very splendid steam frigate. The account states that "the principle of steam propulsion introduced into her must in a short time drive the old-fashioned, wind-resisting, uncouth paddle-boxes out of existence. In her we see a vessel of about 700 tons burden, with an engine of 250 horse power, working a single submerged propeller running out at her stern, capable of making 36 or 37 revolutions a minute, and sending the ship through the water at the rate of 14 or more miles an hour. So far, only two-thirds of her power have been used, and with that she has beaten the *Great Western*. This was done when the *Princeton* drew four feet more water than the *Great Western* did. This tested

her speed, and it is said with confidence that she can beat any steamer in the world. In active service, steamers like the *Princeton* fitted up with the submerged screw, have every advantage over any other kind of vessel. Wheels, boilers, machinery, furnaces, cranks, &c., are all below water line, the top of the highest plate of the boilers being four feet below that mark. No ball can, therefore, come within that distance of any part of the machinery. In the *Great Western*, and in all other steam-ships and frigates, the wheels, smoke pipes, boilers—indeed every part of the whole—is exposed to the shots from the enemy's guns. And in the *Princeton* there is another desideratum, namely, that of burning anthracite coal in her six furnaces, from which no smoke issues. This beautiful vessel is ship-rigged, and when a fair wind is blowing, the screw can be unshipped, canvas spread, and she will then "walk away" with almost any ship afloat. The propeller offers scarcely any resistance, and the *Princeton* has already freely run off before the wind faster than many vessels have in these days." In the first experiment, one of her monster guns, measuring 16 feet in length, and capable of carrying a ball weighing 230 lbs. was fired off; and, instead of "making everything shake," the report was a neat, finished one, not unlike the crack of a rifle on an enlarged scale. In another experimental trip (down the Potomac) on the 20th of February, after a salute of 21 guns from the small pieces, the big gun was put in readiness for the firing of a ball weighing 230 lbs. The word "fire" was given, and all eyes immediately beheld the motion of the ball upon the water, giving some half-dozen bounds, and going at a distance of about two miles before it finally sank. The experiment was in every respect successful. As the vessel was nearing home, the captain concluded to have another fire: the gun was ranged, and fired—the breech exploded! killing with it instantly Mr. Upshur, Secretary of State; Mr. Gilmer, Secretary of the Navy; Mr. Virgil Maxey, of New York city; Commissioner Kennon, Chief of the Bureau of Construction; and Mr. Gardiner, of New York: seriously injuring Captain Stockton, also one of the midshipmen, and three or four of the hands of the ship, and more or less injuring some half-dozen others of the ship's crew. Senator Benton was standing on the right side of Captain Stockton, as were also Mr. Tyson, of Philadelphia, Colonel Strickland, of the same city, and others. The investigation of the cause of this lamentable accident will be found reported at page 60 of the present volume.

The Empire (United States) is 260 feet in length, and measures 1,220 tons—being 200 tons larger than any *fresh* water steam ship in the world! The engine power is 600 horse. The main cabin is probably without equal, being 211 feet (fourteen rods) long, lighted the entire length through painted glass under the roof, and so arranged that it can be divided by folding-doors into three apartments, fitted up in splendid style.—*Mechanics' Magazine.*

UNDOCKING THE GREAT BRITAIN.

Dec. 11 was appointed for the *Great Britain* taking her departure

from Cumberland Dock Basin, bristol; the Bridge crossing the lock, and a portion of its masonry, having been removed to allow of her egress. At about half-past seven o'clock, A.M. having been taken in tow by two powerful steam-tugs, the leviathan began to move gracefully through the water to the entrance of the lock, a third steam-tug being astern of her to assist in the direction of her motions. When, however, she had passed a considerable distance into the lock, moving at the rate of two knots per hour, a cork fender hanging over her side became crushed against the wall: it was immediately chopped away, but as it was then found that in consequence of the prevailing east wind the tide not having risen as high as it should have done by nearly two feet, and the state of the tide being such as would endanger her safety, Capt. Claxton, R.N., the superintending director, who was in the tug which was towing, immediately ordered her back into the basin. This was, very fortunately, safely effected; workmen were immediately employed to remove an additional portion of the masonry of the lock; and on Wednesday night she passed safely through the lock, and lay outside the docks for the night, in order to be in readiness for Thursday morning's tide. At five minutes past eight, she started, being taken in tow by three steam-tugs. On her decks were the directors and several ladies who had been invited to accompany her on the trip. The moment the tugs were put in motion she moved gracefully through the water, amid the cheering of thousands of spectators who lined the banks of the river, and continued her progress to Kingroad, where she arrived in two hours and eight minutes.

Soon after her arrival in Kingroad, the steam was got up, and at half-past 11 o'clock the screw-propeller was put in motion—previously to which she was towed by two Steam Tugs, of 45 horse power each, and with only this power she stemmed both wind and tide; and in fact not only held her own but moved ahead at about 1 knot an hour against a complete head wind and rapid tide, thus proving her superior build. It has been objected against the use of the screw in many steamers, that its action causes them to steer not only very badly, but renders it necessary to have more men at the wheel than under other circumstances, the steering being extremely laborious. The *Great Britain*, however, steered like a boat, with one or two spokes of her wheel, and came round with the helm at 30 degrees, in a circle of less than half a mile in diameter. The superintending engineers, Mr. I. K. Brunel and Mr. Guppy, of course in starting did not intend that this, the first experiment, should be one of full speed, as no new engines can be expected to have properly come to their bearings until they have been worked for some time, and accordingly directions were given to Mr. H. W. Harman, the engineer in chief, to start her at only 6 revolutions, at which she made about 4 knots. On passing Portishead, at 12 o'clock, the revolutions were increased to 9¾ revolutions, which gave 6¾ log—10¼ revolutions gave a log of 7 knots, 10½ revolutions 7½ log; the steamer was kept at this for some time, and then increased to 12 revolutions, when she gave 8 knots as her log. At this period, being then near the Holmes, the

experiment of steering the vessel was tried by turning her round; with the helm hard down she came round in 9 minutes, making a circle of rather more than half a mile in diameter—she was then tried a second time, with the helm at only 30 degrees, when she came round in a beautiful manner in 6 minutes, and in a less distance. When going the straight course, the stupendous mass answered her helm like a boat, taking not more than one spoke of the wheel, and requiring only one man at it. On returning homeward, the speed of the engines was increased to 13 revolutions, at which she gave 8¼ knots; and to 16 and 16½ revolutions, when she went through the water 11 knots, against a strong head wind, passing easily the Sampson, the fastest paddle-boat out of the port, and at this rate of going the steam was cut off by the expansion valve at one foot, or 1-6th of the stroke: 6 of the fires not having been lit during the whole of the trip. The engines worked perfectly smooth, and there was not the slightest vibration or tremor felt in any part of the vessel. The screw propeller, during these experiments, was not fully immersed, her draught of water abaft being only 14 feet 6 inches, and about 12 feet forward, and no doubt existed in the minds of any of those present versed in such matters, among whom was Mr. Smith, the original patentee of the Archimedean screw, that upon the next experiment, or when the revolutions of the engine are increased to 20 in a minute, but that a degree of speed of from 12 to 13 knots could be easily obtained. When the vessel was going 11 knots, the screw propeller was only going 12, making the slip or loss only ⅛th and 3rd per cent, and which slip will of course be diminished when the screw propeller is entirely immersed. When going at her best speed, there was no swell whatever under the bows, her stem cutting through the water just as the fastest Thames boats do. There was but one bearing heated, and that only a little, during the whole experiment, which lasted five hours; and, in short, in every particular, she realized the most sanguine expectations.—The leading details of this stupendous vessel, (with illustrations), will be found in the *Year-Book of Facts*, 1843, p. 10.

DOUBLE CYLINDER DIRECT ACTION MARINE ENGINE.

On March 20, was read to the Society of Arts, a paper "On Messrs. Forrester's Improved Double Cylinder Direct Action Marine Engine," as fitted in the *Helen M'Gregor*, Hull and Hamburgh steamer; the subject was illustrated by models and diagrams. The collective power of the engines is 220 horses, and her tonnage 573; the cylinders are each of 42 inches diameter; length of stroke 54 inches; diameter of air-pump 33½ inches; length of stroke 28½ inches; capacity of condenser, including passage to air-pump, 44 cubic feet; ditto of hot well, 36 cubic feet; paddle wheel 23½ feet diameter to outside of floats; number of revolutions 23½ per minute; average pressure of steam in cylinder 3¾ lb. The engine consists of two inverted cylinders placed "athwart ships," with their stuffing boxes below them, the whole being supported upon wrought-iron columns, resting on the foundation plate, and passing through suitable bosses on the sides of

the cylinders to the entablature plate and crank pedestals. The advantages of this arrangement are, that all the working parts are within the reach of the engineer from the lower floor of the engine, whereby the expense of attendance is reduced. The elevated position of the cylinders obviates the danger sometimes arising from water running over into the cylinders as ordinarily placed. All the moving parts are below the water line, so that they are out of the reach of shot, and lastly the reduction of weight and space is considerable—a saving in length of 25 feet for the engine and boiler room (the tubular boilers) having been effected.

MINIATURE STEAM-ENGINE.

Mr. Warner, an ingenious watchwaker and jeweller, who occupies a stand at the Polytechnic Institution, has completed the model of a high-pressure steam-engine—so small, that it stands upon a fourpenny piece, with ground to spare! It is the most curious specimen of minute workmanship ever seen, each part being made according to scale, and the whole occupying so small a space that, with the exception of the fly-wheel, it might be covered with a thimble. It is not simply a model outwardly: it *works* with the greatest activity, by means of atmospheric pressure (in lieu of steam) and the motion of the little thing as its parts are seen labouring and heaving under the first influence, is indescribably curious and beautiful.—*Mechanics' Magazine*, No. 1109.

SAFETY-VALVES.

Mr. T. Liddle, of Newcastle-upon-Tyne, has patented two improved methods of preventing explosions in steam boilers, the first of which consists of a float appended to a rod, passing through a stuffing-box in the top of a boiler; this rod passes loosely through the end of a lever of the first order, and is finished at the end with a nut or other projection; at the opposite end of the lever is attached the safety-valve, the weight being either inside or outside the boiler; should, by any accident, the water get below a certain point, the float, which is properly weighed, having sunk the nut or projection on the end of the rod, forces down the lever, and, opening the valve, allows the steam to escape. The other method is similar in action to the foregoing, but instead of the float a syphon is attached to the end of the lever, at the other end of which is the fulcrum, and the rod of the safety-valve between. Should the valve stick in its seat, the pressure at the same time acts on the mercury, and, lifting the piston, raises the rod of the valve, and allows the steam to escape.

LOSS OF AN IRON STEAMER.

The following interesting particulars of the loss of the *Elberfeldt* Iron Steamer are extracted from an account of the disaster furnished to the *Times* by a writer who states that he derived his information from Captain Stranach, of the General Steam Navigation Company, and Mr. Bush, the engineer, who was a passenger. The fate of this

vessel may serve to teach certain railers against the Committee of Lloyd's for the cautious course that they have pursued in regard to iron shipping, that the Committee were not so far wrong as has been alleged, when they insisted that evidence was wanting of iron ships being as safe as timber ones under all sea-going circumstances. The question naturally suggests itself—Would any timber vessel have split so suddenly as the iron *Elberfeldt?* We think he would be a bold man who would give an answer in the affirmative. The case of the *Elberfeldt* is one which is evidently not met by the division of the vessel by bulk-heads into different water-tight compartments. The great weight of the machinery amidships must have been the proximate cause of the calamity.—*Editor of the Mechanics' Magazine.*

The *Elberfeldt*, under the command of Captain Stranach, sailed from the Brielle on the 22d inst., at 50 minutes past 6 o'clock A.M. under light and variable winds. On nearing the English coast, Mr. Bush remarked to Captain Stranach that the ship's working appeared to be different from when they left Brielle, and that there was a strong vibration of the vessel. Scarcely had these remarks been made when the suspicions of Mr. Bush were but too truly confirmed; he begged of Captain Stranach to order the boat to be in readiness, for he was convinced that the vessel, being constructed of iron, would afford but a few minutes to save themselves. Whilst this conversation was taking place, an indication of a plain nature gave warning that their fears were well grounded; for about 10 minutes to 3 o'clock P.M. she broke completely in half in the middle. Mr. Bush rushed up stairs, exclaiming; "It is now all over; stop the engines and out boat!" and himself and two others fell headlong into the boat at the moment she was launched: the wind at this time was blowing a brisk gale. Mr. Bush then took the rudder of the boat and kept her head to wind as she was rowed stern foremost towards the vessel to save the remainder of the crew, and to which nautical manœuvre may be attributed the saving of those who were still upon the deck of the ill-fated vessel. The crew of the boat called out to Captain Stranach, who was on the after-part of the wreck, to save himself by springing with an oar into the sea, as her head and stern were collapsing. This was a dreadful moment to all: the wreck presented a most awful, yet grand spectacle; the boiler, bursting by collapse, threw up immense volumes of steam and fountains of water, and the vessel went down with a loud explosion. After her going down, Mr. Bush looked around for the unfortunate crew, and one of the first he saw was Captain Stranach, struggling in the water, supported by a portion of the wreck. The captain and several others were with much difficulty taken into the boat. Three persons were unfortunately lost—two stokers named Wilson, father and son, and the cook, named Andrews. The number saved was 13, including Mr. Bush and Captain Stranach, who, after experiencing the greatest hardships for hours in an open boat, were picked up by the Charlotte, Captain Moyes, who humanely supplied them with dry clothes, coffee, soup, &c. Captain Stranach and Mr. Bush described the whole occurrence

as a dream, for from her breaking to her going down, not more than five minutes elapsed; and what but a short time before, was considered a beautiful model of naval architecture, was sunk irrecoverably in the ocean.

STEAM NAVY OF GREAT BRITAIN.

In Sept. 1841, there were 68 steam vessels of all classes in commission. On July 1, 1844, there were 89. In Sept. 1841, there were 15 steam-vessels in ordinary; in July last there were 12. In 1841, we had 8 on the stocks; now we have building 26. The amount of horse power in 1841 and 1844 is as follows:—

	Sept. 1841.	July 1844.
In commission	9329	13,941
In ordinary	2565	3167
Building	1897	9526
	13,791	26,634

The steam-vessels building are these:—

	Horse-power.		Horse-power.
Terrible	800	Niger	450
Avenger	650	Odin	450
Dragon	560	Gladiator	430
Vulcan (iron)	556	Bulldog	420
Centaur	540	Scourge	420
Sphynx	500	Inflexible	420
Sampson	450	Amphion (auxiliary)	300
Conflict	450	Trident	250
Dauntless	450	Spitfire	130
Desperate	450	And six despatch boats	900

The largest, the *Terrible*, is one-third built, and will be launched before the close of the present financial year; the *Amphion*, 36, is in a very forward state, as are the *Dragon*, *Gladiator* (will be launched in six weeks), *Sampson*, *Inflexible*, *Scourge*, *Trident*, *Vulcan*, the six small despatch boats, and the *Spitfire*. The *Bulldog* has her keel laid down, and will be launched at the end of the year. The *Sphynx* is laid down, the *Centaur* has her timbers prepared, and the frame of the *Avenger* is being cut out. The timbers of the *Conflict*, *Dauntless*, *Desperate*, *Niger*, and *Odin*, are partly prepared, and in course of preparation.—*Naval and Military Gazette.*

OCEAN STEAM NAVIGATION.

The line of steam communication between England and America was established in 1838, by the *Great Western* steam-ship, and maintained by that vessel, the *British Queen*, and the unfortunate *President*, till 1842, without the support of government or any contract for conveying the mails. The line to Halifax and Boston was established by Mr. Cunard, on obtaining a government contract of 57,000*l.* per annum to convey the mails 186,300 miles. The line to the West Indies was established in 1842 by parties who, in 1840, took a contract for 240,000*l.* per annum to convey the mails 684,816 miles. The line to Malta and Alexandria was established in 1840-1 by the Peninsular Company, who took a contract for 31,000*l.* per annum to

convey the mails 72,000 miles. The line between Calcutta and Suez was established in 1842 by the India Steam Company of Calcutta, but no assistance has been granted by government for the mails. The line between Calcutta and Suez in 1843 and 1844 was (and is now) occupied by the Peninsular Company's vessels, with a grant of 20,000*l.* per annum for five years from the Indian Government, on condition of their performing 38,080 miles in the first year, 57,120 miles in the second, and 114,200 in the third.—*Mechanics' Magazine.*

CANAL STEAM NAVIGATION.

Mr. H. Davies (the inventor of the disc engine) has constructed eight towing-boats, fitted with disc engines, for the Birmingham and Liverpool Junction Canal Company, and these are now regularly employed in carrying on an extensive traffic on a line of canal extending from Autherly, near Wolverhampton, to Ellesmere Port, on the Mersey, a distance of sixty-nine miles, in which two trains, usually consisting of six or eight loaded boats, are started from each terminus of the above line every day, and, by this means, a quantity of merchandise, averaging between 2,000 tons and 3,000 tons per week, is conveyed by the use of steam-power on canals. The average weight of merchandise conveyed in each train exceeds 100 tons, and the haulage of this for one mile is effected by the consumption of less than ½ cwt. of coal; consequently, the power of hauling one ton of goods one mile is yielded by the consumption of *less than half a pound of coal.* The engine is managed by one man; the train of boats is steered by one man; and the sole additional attendance is that of a conductor (whose chief duty is to prevent pilferage), except in passing locks, when extra assistance becomes necessary. An equal quantity of goods could not be moved by horse-power, without the continued employment of six horses, with the requisite relays for changing these, and at least twenty-four men on board the boats.—*Mechanics' Magazine.*

SCREW PROPELLERS ON CANALS.

Steam tugs with screw propellers have been successfully introduced on the Union Canal; with boats, the first of the kind introduced into Scotland. They are built of iron by Messrs. John Reid and Co., Port Glasgow; and the engines, screw propellers, &c., are fitted up by Mr. William Napier, sen., engineer, Glasgow. The engines are on the upright principle. They communicate their power to the screws placed on each side of the bow; and by a very nice arrangement of wheels with wooden and iron teeth (in order to prevent noise and vibration), they are driven at a great speed without creating any of that surge or wash on the banks which has hitherto formed the chief objection to the use of steamers on canals. The result of the experiment gave great satisfaction; and, independently of the gain in point of speed, it is calculated that there will be a considerable saving in expense, compared with the ordinary mode of tracking by horses. The steam-boat had attached to her six very large scows deeply laden, but it is capable of towing double the number without material diminution

of speed. The scows to be tracked are connected together by rods having a parallel movement, and all under the control of the steersman on board the steamer, so that the necessity of a separate rudder and steersman for each scow is avoided—the whole train moving along with a steady and uniform motion.—*Glasgow Citizen.*

STEAM-BOAT VENTILATION.

Lieutenant Cook, R.N., F.R.S., has invented a method of Ventilating Steam-boats, which promises fair to add materially to the comfort of passengers by these vessels. A cylinder—in which a solid piston moves air-tight—has two valves at each end; through one opening inwards, fresh air is admitted into a vacuum; which is by the next action of the piston forced through the other valve at the same end, opening outwards into tubes, and by these conveyed to every cabin upon each deck; while the hot, or foul air, is at the same time drawn off from these cabins into a vacuum above the piston, through a valve opening inwards, from whence it is finally ejected through the fourth valve, opening outwards into the open air. The effect produced will, of course, depend upon the size of the piston, and this upon the size of the vessel. One two feet in diameter—the piston having a two-feet stroke—with tubes and valves sufficiently large, would force in about 100 cubic feet, or above 600 gallons, of fresh air (drawing off the same quantity of impure air) every minute! large steam-boats might have two cylinders. The machinery may, in an instant, be disconnected. The fresh air would be conveyed in a regular stream, and not be intermitting in its effect.

HYDRAULIC TRAVERSING RAILWAY FRAME.

A machine of this kind has been constructed at the Bristol terminus of the Great Western Railway. The action of the frame, one of several intermediate lines, is thus described: an opening being made the train, the apparatus is pushed on to the line of rails, and the carriage required to be moved is run over it when the frame is quite down, it being then sufficiently low to allow the carriages to pass freely over. As soon as the carriage is brought directly over the apparatus, a man works a pump, acting upon four hydraulic presses, which raise the frame until both sides are in contact with the axles of the carriage wheels, and raise the flanges of the wheel clear of the rail; the whole apparatus, with the carriage suspended upon it, is then easily transported to any of the lines of rails, when, by unscrewing a stopper, which allows the water to flow back from the presses into its cistern, the carriage is lowered on to the rails, and the apparatus is rolled over, ready for recommencing the operation, the whole transit not occupying more than one minute and a half. The action of the apparatus (made by Mr, Napier) was stated to be very satisfactory, and its cost to have been about 220*l.*

A FLOATING RAILROAD.

A Cincinnati correspondent of the *Newark* (U.S.) *Morning*

Post says :—"I was recently invited to witness the operation of the model of a machine (for boat it could not be called), to navigate our inland water. The inventor is a young man of this place, and, as is usual in such cases, is very enthusiastic in his expectations of its capabilities and powers. He says that the passage hence to Pittsburgh (500 miles) can easily be performed by daylight. It may very properly be denominated a Floating Railroad, or a railroad which lays its own track, and takes it up again when the passage over it has been made. It may be thus described : a series of oblong, air- and water-tight sections of any required length, breadth, and depth, are firmly secured side by side, upon an endless chain ; this chain is distended to its utmost upon a series of cast-iron wheels, supported by shafts, upon a suitable frame-work. These wheels are put into motion by means of the steam engine. The frame-work, with its engine, boilers, and wheels, may be called the locomotive ; the chain, with its floating power of water-tight sections, the railroad. When it is placed upon the water, and the engines are put into motion, the endless chain, or railroad, traverses the surface of the paddles or wheels, by which the sections upon the chain, in succession, are carried forward and enter the water, each doing its part in supporting the whole fabric, and are again taken up in their endless round in the stern wheels. One very novel characteristic of this machine is, its adaptation either to water or land, so that it need not be retarded by sandbars or low water. This is obvious, when it is observed that the floats or sections during the time they are beneath the frame-work (and of course supporting the whole) do not advance at all, but remain stationary, while the wheels pass over them : when they leave the water or land, however, they go rapidly forward to redeem their places on the forward part of the shaft, and to bear up the structure. Upon the frame-work which supports the engine, &c., and above the chain and floats, the cabin for the accommodation of passengers is to be erected. That this thing will move rapidly through or over the water, I have no doubt, but think the enthusiastic inventor has over estimated its powers ; or set too low an estimate upon the resistance it will meet with, from the element through which it is to pass."

ELLIS'S IMPROVED TURN-TABLE.

THE objection to placing turn-tables of the ordinary construction on the main line of a railway is, that, by the nature of their construction, they are rapidly destroyed, by the frequent passage of heavy trains over them, besides the injury done to the carriages, and the unpleasant motion and noise. Mr. Ellis has constructed a turn-table, which, when not in use, rests firmly on the curb, and thus allows the train to pass rapidly over it without injury. The iron pintle of the table on which it turns being well oiled, works with a loose collar round it in a vertical iron case ; which case is supported and kept in its central position by two cross arms of cast iron, at right angles to each other, and attached to the curb. The lower end of the pintle passes through the bottom of the case, below which is a stirrup at-

tached to a cross lever passing at one end through a chase in the circular masonry, or brickwork, supporting the table: attached to the external end of the long lever, is a second lever, working in a vertical direction, and connected with a third, or handle lever, by which the table is put in motion or fixed, as required.—*Civil Engineer and Architect's Journal*, Part 80.

RAILWAY VIADUCTS.

THE cheapest Stone Viaduct in England is probably the Dutton Viaduct, over the Weaver, on the Grand Junction Railway. It is on a piled foundation, and carries the line over the navigation at a height of 65 feet, in twenty segmental arches, of 60 feet span. It is about 80 feet from the foundation to the level of the rails, 1484 feet long, and taken at 30 feet wide will be found to fill a chasm of 130,000 cubic yards, at a cost of £53,000; being about 8s. per cubic yard.—*Railway Chronicle*.

APPLICATION OF ANIMAL POWER ON RAILWAYS.

A NEW mode of applying animal power to locomotion on Railways has been contrived, by means of which the horse may be able to rival in speed the fatest steam locomotive; and for this purpose the heaviest dray-horse will answer better than the swiftest racer. The means by which this apparent enigma is solved are these: the horse, or horses, is or are placed within a large drum having projections on its inner circumference, whereon the animal may gain a purchase for its feet. To the axle of the drum is fixed a large cog-wheel working into a smaller one, connected with the axle of the carriage wheels which run on the rails; thus one turn of the drum may be made to give any number of rotations to the driving wheels. The horse goes on like a squirrel in its cage, the action of its gravitation, as it takes an ascending step each time, being the cause of rotation, and of onward motion to the carriage. This application of animal power is similar to that of the tread-mill, which in many prisons is turned to good account; and horses are thus sometimes employed in turning machinery where there is not space for a walk, though it is a mode of employing their power not adopted by choice. The invention, as applied to railways, has a foreign origin; and though we have not much faith in its efficacy, as compared with steam, we have a curiosity to see the experiment tried on an English railway.—*Artizan*, No. 13.

NEW METHOD OF CLOSING THE PNEUMATIC TUBE OF ATMOSPHERIC RAILWAYS.

IN the system adopted by Messrs. Clegg and Samuda, the Tube, as is well known, is closed by means of a long band of leather, which is free on one side, and fixed by the other to the edge of the longitudinal slit that allows the passage of the rod by which the piston is united to the first waggon of the train. Being raised for a moment to allow the passage of this rod, the band immediately falls again; a lever, the motion of which is connected with that of the piston, afterwards

presses it against the opening, and an unctuous substance further contributes towards rendering the adhesion more complete.

Now independently of the unctuous body's appearing readily to undergo alteration by contact with the air, the leathern band must gradually lose its suppleness, and tend, in places, to rise a little, after the passage of the compressing lever; it is, therefore, desirable that the closing of the longitudinal fissure, instead of being due to the action of a transient effort, should result from a constant action exercised in each point of the fissure. For this purpose, M. Hallette has arranged on the upper surface of the pneumatic tube, and bodily connected with it, two longitudinal semi-cylinders, or rather two gutters placed lengthwise, with their concave parts facing. Each of these gutters contains a gullet, of elastic material, perfectly impervious both to air and to water. When the two gullets are sufficiently inflated with air, they touch each other by one part of their surface; they act as do the lips of the human mouth, and thus entirely intercept communication between the interior of the pneumatic tube and the exterior air. When the piston moves, the rod which connects it with the train slides between the two tubes, which unite again immediately after its passage. This rod, the horizontal section of which is a meniscus, and which hence penetrates, like a wedge, between the two gullets, acts upon them with scarcely any friction. However, in order to ensure their durability, M. Hallette has thought it advisable to protect them with leather at the parts by which they come in contact.—*Communicated by M. Hallette to the Academy of Sciences, at Paris.*

ROCKING MOTION OF LOCOMOTIVE ENGINES.

AT the Society of Arts, on the 31st of January, Mr. G. Heaton's paper "On the principal cause of the rocking motion of Locomotive Engines and Carriages" was read; and several experiments, with machines made for the purpose, were shown by way of illustration. Mr. Heaton's attention was first drawn to the subject early in the year 1838, when employed to examine a steam-engine and machinery used for making boiler plates, rolled bars, &c. He found that the fly-wheels of the engine, when revolving rapidly, made a very rumbling noise, and the lighter one would jump as high as the gland would let it; indeed the whole building rocked when the machinery was in motion. It was found that the fly-wheels were heavy sided, and that the smaller one (16 feet in diameter) required 160lb. on one side, and the larger one (18 feet in diameter) 322lb., to equipoise them. This having been done, the whole of the machinery moved easily and quietly. This result caused the author to turn his attention to the rocking and jumping motion experienced in locomotive engines and carriages. The difference of speed at which the different parts of a wheel in motion progress, or the speed at which bodies descend through short distances, does not appear to have been taken sufficient notice of by engineers, as the heavy side of a wheel has to fall at certain intervals during its revolution sixty times as fast as it would fall by gravity alone. When a railway engine is travelling at the rate of

33 miles per hour, the top of its wheel is thrown forward at the rate of 46 feet in a second. Railway carriage wheels are frequently 6 to 7lb. heavier on one side than the other; it is no wonder, therefore, that the unpleasant motion experienced while travelling in carriages so circumstanced, is so often complained of. Without entering into detail with regard to the different machines used for the purpose of illustrating Mr. Heaton's views, it may be well to describe the most simple one, and the method of making the experiments. The model is made to represent the wheels and axle of a railway carriage, the axle being 16 inches long, and the wheels 6¼ inches diameter. By placing some loose pieces of iron inside the rims, so as to represent wheels which are one-sixth of an inch thicker on one side than the other, the thick side of one wheel being placed opposite the thick side of the other, at the opposite ends of the axle, according to the common practice, and the wheels allowed to revolve, the model will continue to jump about the table (on which it is placed) so long as the wheels are in motion. Again, if the pieces of iron be all placed on the same side of the centre, the model will not rock as before, but jump up and down and make more evolutions than in the last case. The wheels being perfectly equilibriated, will revolve without any oscillating movement, and the frame remain quite steady, the number of revolutions, with the same power, being considerably increased. The paper was accompanied by tables, showing the effects produced by experiments made under different circumstances.

SOLID AND HOLLOW AXLES.

On April 23, a paper was read to the Institution of Civil Engineers, by Mr. C. Geach, who had promised, at a meeting of the Institution in February 1843, to give the results of more extended comparative trials of the Strength of Solid and Hollow Axles. The result of the present experiments was as decidedly in favour of the solid axles as the former ones had been in favour of the hollow ones; so that, as far as the practical utility of the examination extended, the results were useless. A paper was then read by Mr. Glynn, relative to the fracture of railway axles, which he attributed to the constant succession of blows received by the axle in travelling. The action was stated to be similar to that of an axle laid on the edge of an anvil, and subjected to a series of smart blows of a hammer while in constant rotation. The fracture presented the appearance of a clear annular cleft, all round, for a depth of half an inch in the body, the centre part being crystallized and reduced so much as to be unable to bear the weight, and the portion to which the axle was subjected by the pressure of the break on one of its ends. These observations had induced the Railway Company to apply the power of the break to both wheels simultaneously, thus avoiding the torsional strain.

CONTINENTAL COAL DISTRICTS.

From two Reports which have been published on the projected Sombre and Meuse Railway—one by Mr. Sopwith, the eminent eco-

nomical geologist, and the other by Mr. Cubitt, C.E.—we glean the following remarkable facts respecting the mineral riches of the districts which it is intended to traverse. First, there is a coal basin, extending over an area of upwards of 600 square miles; the produce of which amounted in 1842 to upwards of 3,059,183 tons, being more than three-fourths of the entire quantity of coal raised in Belgium. Mr. Sopwith states that, "as compared with its superficial area, Belgium possesses nearly the same relative area of coal deposits as Great Britain!" Next there are fields of iron ore, which are of almost inexhaustible abundance, and which, though as yet only partially worked, yielded, before the late depression in the iron trade of Belgium, 569,827 tons annually. Slate quarries follow, producing sixty millions of slates per annum; with beds of limestone and marble, to the productiveness of which it seems impossible to set limits. Besides furnishing an outlet for these vast stores of mineral wealth, the projected railway will form a most valuable medium of communication, not only between the numerous towns and villages which it touches, or comes within an available distance of, but between the principal ports and cities of Belgium and the manufacturing towns of the Ardennes. It will be connected also with lines of railway, now either in progress or projected, to Paris on the one hand, and to the Upper Rhine and Switzerland on the other.

AIR-PROPELLED LOCOMOTIVE.

M. Arago has communicated to the Academy of Sciences, at Paris, an account of a new system of Locomotion, proposed by M. Andraud. This gentleman recently performed with success some experiments with compressed air, at a high degree of pressure, on the Versailles railroad (left bank); and the question that remained to be decided as to the advantage of substituting compressed atmospheric air for steam as the motive power of engines, was that of expense. His present discovery, however, is altogether different from the system on which he made his experiments on the Versailles railroad, for it consists in employing atmospheric air at a comparatively low pressure, and consequently at a comparatively small cost. The mode of operating is also quite different. He was present at the Academy, with a working model, and exhibited it in action. The system consists of a long flexible air-tight tube, placed between the two rails on the whole length of the line. At the extremities of this tube are reservoirs filled with compressed air. A kind of flatting-mill is fixed at the head of the first carriage of the train, and the tube is pressed gently between the two rollers. This is the whole of his apparatus. When the train is to be set in motion, one of the reservoirs of compressed air is put into communication with the tube, which swells, and the air, meeting with the obstacle of the rollers, acts upon the mill, which performs the office of a piston, and the train is impelled with more or less rapidity, as the pressure upon the air is more or less violent, and according to the diameter of the tube. In this process here is, of course, no engine, and the carriages are carried with con-

siderable rapidity up any moderate elevation, and can be made to ascend at a lower rate the highest hills.

REPAIR OF WESTMINSTER BRIDGE.

The knotty question of the repair of Westminster Bridge, and the relative merits of Gothic and Curvilineal arches for bridges, has been widely agitated by Mr. Barry's and Mr. Walker's reports on the subject. Mr. Barry maintains that all the money and labour hitherto bestowed on the repairs of Westminster Bridge have been thrown away, and that the only plan is to commence *de novo* from the foundation, and to build a bridge with Gothic arches, and in a style of architecture corresponding to the new Houses of Parliament. Mr. Hoskin deals generally with the subject, but he supports Mr. Barry's views regarding the applicability of the Gothic arch to bridges. Mr. Walker, of course, defends himself and his works, and there appears indeed to have been much exaggeration in the statements respecting the settlement of the bridge. He contends that the Gothic arch is less fit for bridges than the circular or ellipse, as it is less strong, and cannot give an equal space for the passage of vessels underneath, with a similar height from the roadway. He observes, also, that as a question of taste, a variety in the style of architecture would be a relief to that of the Houses of Parliament; and that, as there must be an end to the Gothic style somewhere, it could not come to a more fitting termination than at the bridge. At length, the question has been disposed of by negativing Mr. Barry's proposition for a new bridge.

HUNGERFORD SUSPENSION BRIDGE.

This beautiful bridge, crossing the Thames from Hungerford Market to the Belvidere Road, Lambeth, will be completed in the ensuing summer. The entire length of the Bridge suspended on chains will be 1,342 feet 6 inches—that is, the centre span or arch, 676 feet 6 inches; those on the side 333 feet each. The width within the chains will be 14 feet, and a clear pathway of 13 feet; the height of the flooring above high water (Trinity standard), in the centre 31 feet 6 inches, at each pier 28 feet 6 inches, and at each abutment 22 feet 6 inches; the height of each pier above the flooring 55 feet 3 inches; the number of main plates which form the chain is 2,500, about 24 feet each in length. The total weight of iron is between 700 and 800 tons, and the estimated cost, including the approaches, is £110,000. It will be seen that its centre span alone is nearly 100 feet greater than the entire of the celebrated Menai Bridge, which is 579 feet 10 inches. It is likewise 274 feet greater than the centre span of Hammersmith Bridge, which is 402 feet 3 inches; and above three times as great as the centre arch of Southwark Bridge, at present the largest in London. Indeed, with the exception of the wire bridge at Fribourg, in Switzerland, which is 870 feet, it will be by far the largest in existence.—*Mining Journal.*

BRIDGE FROM MESTRA TO VENICE.

THIS stupendous bridge will cross the *Lagoon*, which is a large *shallow surrounding Venice on all sides, and, in former times, a great protection against the enemy; this lagoon has from two to five feet of* salt water, on a sandy bottom; where the channels intersect it, the depth of the water is from forty to fifty feet. The bridge is commenced in many places, and there are upwards of 147 arches *finished;* the masonry of the arches is all *stone*, and the piers, placed at certain distances, are of brick faced with stone; the top of the arch to the surface of the water is about twelve feet. No one besides those persons who have seen it can imagine the difficulties and labour required for this gigantic work; every morsel of earth, stone, brick, lime, iron, wood for framework and for the coffer-dams, together with the fresh water for making the cement, is brought in boats from the mainland, a considerable distance, and yet this has all been surmounted by the indefatigable zeal, talent, and industry, of a German engineer, Milano, by whom the extraordinary undertaking is superintended, planned, and executed.

It is supposed that, in addition to the bridge being a viaduct for travellers, merchandize, &c., it will also be an aqueduct to supply fresh water to Venice, which, up to this time, owes all its supply to a few rain-water tanks, and to the fresh-water boats which bring the water from the river Brenta, not very a viting instream. It will indeed be a grand triumph of art when Venice is independent of the water boats by fresh water carried on arches over the sea. The railroad itself will finally go on to Milan; at present it only runs from Mestra to Padua, about one hour's steam. The engines, and one-half of the iron rails, are of English manufacture.

A NEW PROPELLER.

AN invention has been made by an ingenious mechanic of Edinburgh, of a new mode of giving motion to vessels, doing away with paddle-wheels and boxes, as well as the Archimedean screw. It is a simple revolving cylinder, placed midships, which acts as a windlass, and makes a rope of the sea; in fact, the velocity acquired is in proportion to the quantity of water discharged by the agency of the cylinder through a discharging nozzle at each side of the vessel, and what is curious, the discharging nozzles can be turned by a simple operation on deck, so as to stop the vessel, make her move backward or round as on a pivot, within her own length, without even the knowledge of the engineer, or the assistance of the rudder, as no stoppage of the engine is necessary for the purpose. The convenience is a smaller consumption of fuel, and the capability of the broadside carrying an entire armament.—*Scotsman.*

NEW DIRECT-ACTION ENGINE.

MESSRS. SCOTT, SINCLAIR, AND CO., of Greenock, have constructed a Direct-Action Engine, which the Conductors of *The Artizan* look upon as being superior, after a few trifling modifications, to any that

has yet come under their notice. The plan admits of a long connecting-rod, and a long stroke, without rising above the deck, as in the case of the steeple engine, and at the same time occupies no more length in the ship than is necessary for the cylinder, and the projection of the valve casing.

Each engine has a cross-head and side-rods, as in a common side-lever engine; but the bottoms of the side-rods are maintained in the vertical position by substantial double guide-rods, the eyes working upon which are provided with deep stuffing-boxes, which may be screwed up as the guide-brasses wear. From the bottom of each side springs another side-rod, which joins a single crank on the shaft, and the two cranks of each engine are placed so far apart as to enable the cross-head to ascend between them. By this means, the cross-head may ascend as high as the upper extremity of the crank when on the top centre, or even higher, so that a long stroke is thus realized with long connecting-rods. The air-pumps are wrought by means of horizontal rods, extending from pins near the top of the connecting-rods to upright levers fixed upon a rocking shaft; and a lever may extend again from this shaft to the space between the engines, to give motion to an air-pump in that situation.—*The Artizan*, No. 21.

HYDROSTATIC TELESCOPE.

A CORRESPONDENT of the *Athenæum*, No. 894, suggests a mode that had lately occurred to him of extending the scale and enlarging the powers of the *achromatic telescope*. It is well known that the chief impediment at present obstructing this advance is the difficulty of maintaining a tube of the requisite length that would be easily moveable, both perpendicularly and horizontally, without being subject to the strains and consequent relative derangement of the lenses, arising from the great length of each arm projecting so far beyond the point of support.

Now to remove this difficulty, and allow the tube to be sustained throughout its whole length, while, at the same time, it would remain easily moveable, both perpendicularly to a sufficient extent to enable one to follow the heavenly object, and also horizontally, the writer proposes that there be a circular pond or basin of still water, nearly of the diameter of the wished-for length of tube. In the centre of this basin let there be a piece of solid masonry projecting in the form of a truncated cone, a little above the surface of the water. Again, let there be a long narrow water-tight box, nearly of the length of the tube or diameter of the basin, having a gap or vacancy in its bottom at the centre capable of freely admitting the central pier—so that the box's flat bottom throughout its whole length (except where intercepted by this gap) would rest upon the water. Let a strong shaft, with its lower end fixed firm in the masonry, rise up from the pier through the centre of the box, and form the support of the axis of the tube, with the necessary joints to enable it to perform that office. Along the floating box, again, and at proper intervals, let there be a double row of uprights, of the necessary length, in pairs,

one on each side of the tube, to act as its supports, and each having a longitudinal groove or slit in it, to admit a slip of wood or other material to shift up and down between each pair of standards—this slip to be fixable at any height, and to have a semicircular hollow in its upper edge to receive the tube. As high up as possible on these standards, let them be connected together longitudinally by a rail, with occasional diagonals, or stays, rising to them from the box, so as to ensure the box against strains when one end of it is depressed into the water more than the other in the act of following the object. According to the construction, the tubes need not be of one piece, but of as many portions as may be found convenient, and merely laying these portions in a line, or perhaps pushing the end of one a little into that of the other, while placing them upon the slips, will ensure the stability of the tube throughout its whole length, in the smaller motions necessary for keeping the object within the field of view. Of course, however, before commencing the observation, the slips would require to be arranged according to the altitude of the object, and the tube placed accordingly: and if that altitude altered much during the observation, this process of occasionally relieving the floating box, and rearranging the slips, would require to be repeated. The mechanism would require farther to admit of being so adjusted that the entire weight of the whole would not rest upon the water, but a portion be borne by the central shaft. In this way one can see no limits to the length of tube that may be employed.

INDUSTRIAL EXHIBITION, AT PARIS.

This grand display of the industry of France was opened on the 1st of May, and exhibited for two months, in a large building constructed for the purpose inthe Champs-Elysées. This exhibition was the tenth of its kind since the year 1798. We are not aware of the precise number of exhibitors, and of medals awarded; but, in the year 1839, the exhibitors were 3,381; and the medals 805.

The Exposition of 1844 comprised a great number of beautiful productions of French art, some few of which have been purchased, and brought to this country. Several of the finest specimens have been engraved and described in *L'Illustration*, Vol. 3. The Exposition appears to have been visited by thousands of persons; and by Louis Philippe, who in June last, gave a splendid fète at Versailles, in honour of French industry, to about 1500 persons—*manufacturers*, peers of France, and diplomatists. This *kingly* patronage of the industrial arts will, we hope, have its influence throughout the states of Europe.

THE DECORATIVE ARTS.

The progress of the Decorative Arts during the past year has been truly gratifying; and has tended very considerably to heighten the taste for interior decoration in buildings of every grade. The attention of the Decorative Art Society has already been directed to several very important subjects. At the Society of Arts, and the School of

Design, prizes have been awarded for some very promising productions; and the Exhibitions in connection with the interior fittings of the New Houses of Parliament have manifested great advances in this branch of ingenuity. The interiors of several new churches, opened within the year, have likewise borne evidence of improved taste; though, in many instances, it be in *revival* rather than invention.

ECONOMY OF FUEL IN LOCOMOTIVE ENGINES.

On April 8th, the Secretary read to the Society of Arts, a paper by Mr. C. Tetley, on certain phenomena of Steam, and on his plan of economising fuel in the boilers of locomotive engines. The evaporating power of a boiler, says Mr. Tetley, is dependent chiefly on three causes: 1. The amount of boiler surface exposed to the reception of heat; 2. (and very materially) on the shape of the boiler; and 3. on the intensity of the heat. The heat derived from that part of the boiler immediately over and about the fire he calls (according to usage) "radiating heat," while the heat derived from the tubes or flues he calls "carried heat." Mr. Tetley describes his improvement to consist of a division of the boiler into two or more compartments of different heating temperatures, having channels for feeding the compartments with water from that or those containing water of a lower temperature. The first partition is placed vertically over the water space at the back of the boiler, the top of which reaches somewhat above the water-line, and the bottom below the level of the fire-bars, leaving a passage for the water beneath it. The second partition reaches from the bottom of the tubular part of the boiler to a little above the level of the fire-box, and is removed but a short distance from the first partition. The third partition is placed in the middle of the tubular boiler, and, as the first, runs up above the water-level. A communication is formed for the supply of water, by a pipe running from the compartment nearest the chimney-box into the middle compartment, the top of the pipe being just under the top water-level, and the bottom of the pipe entering the middle compartment at or near the bottom of the boiler. On evaporation taking place, the steam diffuses itself over the top of the partitions, thus maintaining the same pressure on the surface of all the water. Evaporation commences in the compartment over the fire-box, and the water, converted into steam, is reinstated by the surface water from the second or middle compartment, which is delivered almost or entirely at the evaporating point. In like manner the middle compartment is kept continually fed from the top layer of water in the third compartment, which is supplied by a pump in the usual way. By this arrangement, Mr. Tetley states a saving of fuel equal to about 21 per cent. is obtained, the prevention of a body of sediment is effected, the steam is got up more rapidly, and the action of a float for regulating a feed apparatus is rendered much more certain.

IMPROVEMENTS IN STEAM-BOAT PROPULSION.

NOTWITHSTANDING the number of inventions (many of which have been patented) for the improvement of the float boards of the paddle wheels of steam-boats, some of which are of a complex and expensive nature, the majority of steam-boat paddles retain almost the simple form originally introduced upwards of thirty years ago, with, perhaps, some little modification—viz. the rectangular wood float—some now, though still of the same shape, being made of iron. The disadvantages attendant upon this shape have been long known to naval engineers, consisting of a succession of shocks from their impinging on the surface of the water, at an angle injurious to the propulsive power of the engine, causing all that unpleasant vibration more or less experienced on board, and straining the machinery to an unknown degree, as well as the farther retardation of power, by their lifting the backwater at the moment their effective force is expended; the only attempt to get rid of these evils hitherto, has been by the certainly ingenious method of reefing (for which, we believe, two or three patents have been had, and expensive lawsuits sustained), that is, by the working of levers and other machinery, making the float enter the water edgeways, avail of its entire propulsive power while beneath, and the moment when from the rotation of the wheel, that power is expended, cause it also to leave the water in a vertical position. Paddle-wheels on such principles are, however, necessarily complex, expensive in the first instance, and very liable to get out of repair; all these objections have now been removed by an invention of Mr. Smart, ship-builder, of Bristol, which he has secured by patent; he terms it the Elliptical Convex Metallic Paddle-float, and consists of sheet-iron, the outer edge formed into curved or elliptical shape, with rounded ends, then hammered out in a concave shape, and so placed on the wheels that the central point of the *convex* side enters the water first; the float thus meeting the retarding fluid gradually, prevents all vibration, and on its leaving the liquid element, its convexity being uppermost, it has no backwater to lift, and offers little retardation to the full power of the engine. This is also not mere theory, their action has been fully tested; the *Shamrock*, a fine vessel running between Bristol and Dublin, having increased her speed a full knot per hour, and enabled her to save her tide in a voyage between these two cities. The *Swift*, running between Bristol and Newport, has gained a knot and a half, and the *Osprey*, a vessel of 200-horse power on which the patent was first tried, though imperfect, immediately gained a knot per hour. We may remark it as singular that in 1819 or 1820, the *London Engineer*, then considered a large boat, with 80-horse power engines, making ten knots with common floats, was all at once to do wonders, as she was to be fitted with scoop or *concave* floats, and gain at least one knot per hour with this "simple contrivance;" but, behold, on the experiment being made, the ten knots dwindled down to seven, and the common float was restored.—*Mining Journal.*

NEW STEAM-PRESSURE GAUGE.

M. Collandeau has presented to the Academy of Sciences, at Paris, through M. Arago, a Pressure Gauge for Steam Boilers, &c., using high pressure, upon a principle totally different from that of the manometer. It is well known that great practical difficulties exist in the formation of accurate manometers acting upon the principle of Marriott's law, and that when made they are liable to certain errors of principle and of construction, difficult or impossible to eliminate. Collandeau's instrument is intended to remove this. It consists, in fact, of a sort of thermometer (so far as form goes),—the tube of glass, and the bulb, which is flattened, of a flexible and elastic metal, (such as palladium, probably) filled with a fluid. The metallic scale contains certain arrangements, not yet fully described, to compensate the effects of expansion by change of temperature of the fluid and of the scale, so that the pressure of the medium in which the bulb is immersed remaining the same, the height of the fluid column and the tube shall be constant, no matter how the temperature around the instrument may vary, within certain limits. Now, when the flexible bulb is placed in a steam boiler, it is obvious that the column of fluid in the tube will rise or fall, according as the pressure upon the bulb compresses it or permits it to regain its former volume, and thus indicate the variations of steam pressure. The accuracy and value of the instrument, of course, wholly depends upon the degree of accuracy possessed by the contrivances for compensation as to temperature.

PRIMING OF BOILERS.

Mr. David Napier, of York Road, Lambeth, has patented certain "Improvements applicable to Boilers, or apparatus for generating steam," intended to prevent what is technically called priming or flushing; or, in other words, the water from passing off in conjunction with the steam, and is effected in the following simple manner. The surface of the water in the boiler is covered with one or more tiers of hollow metallic balls or other buoyant substance, or the same may be effected by substances that are not buoyant; such as perforated plates, supported in the boiler by any mechanical means, or wood may be advantageously employed; but the patentee prefers hollow metal balls of about 2 inches diameter: a tier of these balls being placed upon the surface of the water form a number of interstices, which will be greatly reduced by placing another layer or tier upon the first, and the same will prevent the water, when in a state of ebullition, from rising up and passing off in conjunction with the steam. The claim is for the method above described of preventing the priming and flushing, of whatever form or material the substances employed, and whether buoyant or supported by mechanical means.—*Civil Engineer and Architect's Journal*, Part 78.

PREVENTION OF INCRUSTATION IN BOILERS.

This invention is a method of hindering Incrustation on Boilers, which is a very bad conductor of heat, and causes great waste of fuel.

This is accomplished by putting a quantity of common salt into the boiler at regular intervals, which not only keeps the boiler clean, but causes the incrustation already formed to fall off. It is, however, unsafe to put salt into a boiler much "furred," especially a land engine boiler, when the fire acts directly on the bottom, as the slabs of lime falling on the plates above the fire might cause them to be injured, by keeping the water from the plates. The best method, therefore, is to clean out the boiler as well as possible before using the salt, and then putting the salt in regularly, which might be done once each week by dissolving it in hot water, and pouring it in by a convenient cock. Land engine boilers, fed from springs or filtered water, might be left unopened for twelve months, or even longer, if care be taken to supply them with salt (a little too much will do no harm), and the boilers filled with water above the ordinary level, before the engine is stopped for the night, and the surplus blown off: this may be done about twice a week.

Steam-engine proprietors will find a great saving in pursuing this method, both in boilers and fuel. The quantity put into a pair of boilers of 40 horses power is about 8 lbs. every 8 days, when the river is low, and less when the river is swelled with rain, as then the water contains proportionally less lime. The chemical action of the salt on the lime is simply as follows:—The salt (muriate of soda) mixes with the water, forming a new combination with the lime, either in the state of a carbonate or a sulphate, forming in the first case muriate of lime and carbonate of soda, and in the second muriate of lime and sulphate of soda, all soluble salts, which do not injure the plates. Mr. Hall has employed this method during five years.—*Mechanic's Magazine*, No. 1074.

FORMS OF SHIPS.

MR. SCOTT RUSSELL has reported to the British Association, that the Committee on the Forms of Ships have completed their labours; that the whole of the tables of the experiments, and all the drawings of the forms of the ships, are now ready for publication. These tables were so voluminous, and the plates required for illustration were so numerous and expensive, that the question of publication was likely to be attended with some difficulty; but a Committee, consisting of the President of the Royal Society, the Dean of Ely, Col. Sabine, and Mr. Taylor, had been appointed for the purpose of making the necessary arrangements. He had now to communicate to the meeting an important addition which had been made to these experiments during the past year. The members of this Section were aware that the former experiments made by the Committee comprehended vessels of many forms, and various sizes, from the length of a few inches, to ships of 2,000 tons displacement, but in all these experiments direct mechanical means of propulsion had been employed, and not the force of the wind, and they were therefore regarded as applicable to steam vessels, rather than to sailing-ships. During last year, however, most satisfactory experiments had been made, in which the propelling force

was the wind acting on the sails of the vessel on the open sea. 'The circumstances in which this experiment originated displayed in a striking manner the advantages conferred by an association like this on the districts which it visited. The two gentlemen who had conducted this experiment were both Irishmen: one, Dr. Corrigan, of Dublin, having become acquainted through the last meeting in Cork, with the experiments of this Association, determined on building a pleasure-boat to carry out the principles which had been established by those experiments, and to have his vessel built on that form which was pointed out by these experiments as the form of least resistance. He, accordingly, built a small vessel of about four tons measurement, in the wave form, for the purpose of making experiments with it as a sailing vessel. The other gentleman to whom we were indebted for this experiment was Dr. Phipps, of Cork, now in London, who had formerly distinguished himself as a naval constructor, and had invented a form of his own, which had been attended with great success. At the last meeting in Cork he had become acquainted with the wave form, and it was under his superintendence that an experimental vessel had been built on the Thames, during last summer. The vessel had been tried on the Thames by Dr. Phipps, and subsequently in the Bay of Dublin, and the results of the experiments were laid before the meeting in the letters which had been received from Dr. Phipps and Dr. Corrigan. From these letters it appeared that the performances of this small vessel had been surprising. In speed she had already beaten every vessel with which she had been tried, and these included pleasure boats and yachts, some of them of high reputation for speed, and of four times her size. It was of course difficult to conduct experiments of this kind with mathematical precision, but the reports stated that the experimental vessel was not only fast before the wind, but weatherly, dry, stiff, and easily worked. The experiments on this vessel were still in progress; and unless she should in future be beaten by some vessel of her own size, and of a different form, it would appear from these reports that the wave form might be adopted with as great advantage in the construction of sailing vessels, as it already had been in the construction of the fastest class of steam vessels.—*Athenæum*, No. 883.

THE HOGGING OF SHIPS.

The weight which a body has when it is immersed in water is always the weight of as much of that water as is equal in bulk to itself; that is, a vessel displaces a volume of water equal to its own immersed bulk; consequently, the stern-quarters, rudder, &c. not receiving any support from the fluid, naturally fall, and cause what is nautically termed "a broken back."

Many line-of-battle ships in ordinary have on board seven hundred tons of iron ballast, being about four hundred tons more than is required for her trim; and, when a ship is ordered into commission, she goes alongside the jetty to take out this centre weight, which considerably retards her equipment; and it must be obvious to every one, if a

vessel requires seven hundred tons for this specific purpose, the sudden removal of it from the centre, and more particularly when alongside the jetty in high tides, with the mooring-chain on the quarters and bow-port pressing her down, considerably accelerates this weakening of her frame. This was clearly demonstrated by the appearance of the copper of the Implacable: she had five hundred tons of iron ballast amidships, and when it was taken out, the copper became ruffled, and she evidently showed every indication of being broken; for when placed in dock on the blocks, it was partly removed, but on coming out of dock it immediately assumed its former appearance. It is, therefore, abundantly clear, that the ballast placed in the centre, with a view of preventing a ship from being broken, acts diametrically opposite on its sudden removal, and occasions this visible weakness.—*Fisher's Colonial Magazine.*

PROPELLING SHIPS.

Mr. Joseph Maudslay, of Lambeth, has patented the following improvements in machinery used for Propelling Vessels by Steam. These improvements are applicable to the mode of communicating motion to screw propellers generally, and to the means of placing the propeller so as to obtain greater effects from its action. A difficulty has hitherto arisen in the application of the power so as to obtain a rapid rotatory motion. Cog-wheels and pinions have been employed, and bands, or ropes, passing over large and small drums to multiply the motion, but both those plans are objectionable, and the cogs or bands are liable to be broken. Mr. Maudslay endeavours to obviate this difficulty by causing many convolutions of rope to pass round the drums, the rope of the opposite extremities being connected by guide-pullies, by which means he greatly adds to the strength of the rope by distributing the tension over a number of parts. The endless rope is kept tight by another drum, which is forced against it by a lever and screw when the rope becomes stretched. In the second part of the invention the propeller is placed beyond the stern-post, where the rudder usually is situated, and the ship is steered by *two* rudders placed under the stern quarters, one on each side of the propeller. It is customary to place the propeller in the "dead wood" of the vessel behind the stern-post, so that part of its action is obstructed. In Mr. Maudslay's arrangement he proposes to remedy this defect, for there is no part of the vessel to interfere with the action of the propellers on the water. The rudders may be used either separately or together, as required.

EXTRAORDINARY HYDRAULIC PERFORMANCE AT WOOLWICH DOCK-YARD.

A most interesting exhibition of Hydraulic prowess has taken place in Her Majesty's Dock-yard at Woolwich, where there is a floating caisson of large dimensions, from which it is occasionally necessary to remove the water. This has hitherto been accomplished by means of a pair of ten-inch pumps, fitted up in the best possible manner by an

eminent engineering firm in London. These pumps have been worked by a party of thirty-two convicts, in two gangs of sixteen each, relieving each other at intervals of ten minutes, by which means the water has been pumped out in three hours and a half, the men at the end of that time being much distressed by their continued exertions. Mr. Walker (of Crooked-lane, King William-street,) having offered to raise the required quantity of water *in half the time*, with *half the number of hands*, by means of his new invented pump, his proposal was made known to the Board of Admiralty, who immediately called upon Mr. Walker to fulfil his promise. He, accordingly, fitted up a pair of twelve-inch pumps worked by a rotatory motion, which were completed and tried on the 20th of Semptember last. The new pumps were manned by fourteen convicts (the same formerly employed in this work) in two gangs of seven each, relieving each other at intervals of fifteen minutes. In *one hour and fourteen minutes* the required task was accomplished, the men being in no way fatigued! The quantity of water raised was about 3,350 cubic feet, or 95 tons, lifted 13 feet high! The result of this trial created great astonishment among all present.

By placing a second pair of Mr. Walker's improved pumps in the caisson, it may, in case of emergency, be emptied in half an hour by 28 hands, although with the former pumps 32 men could not accomplish that task in less than three hours and a half. It is always very desirable to have the power of quickly emptying the caisson, but under certain circumstances (in the event of fire, for instance) it is of the utmost importance to be able to do so.

HYDRAULIC RAM.

A PAPER has been read to the Society of Arts, describing the Hydraulic Ram, invented by Mr. Roe. The machine consists of a rectangular body, at one end of which is the supply pipe from a reservoir of water collected from a running stream. At the top of the body, at one end, is a circular pulse valve—at the bottom end, a spherical air chamber having a circular neck, into which is inserted a pipe leading into the cistern to be supplied with water. The action is as follows: the water entering the body of the ram with a pressure in proportion to the area of the supply pipe and fall, closes the pulse valve, and immediately enters the air chamber through a valve in its neck. The air in the chamber being compressed, causes the neck valve to be closed, and thus liberates the pulse valve. When the air in the chamber is sufficiently compressed, some of the water therefrom is forced into the pipe leading to the cistern. The same action is continued as long as the ram is supplied with water from the head. The son of the celebrated Montgolfier introduced a small valve into the neck of the air vessel, to supply it with fresh air, but the author is not prepared to say that it is successful in practice. By this machine, with a 10 ft. fall, a column of water, 150 ft. high, may be raised at the rate of 5 quarts per minute—thus giving 1 part raised to 11 wasted. There are many situations where small streams, now running to waste, might

be rendered available for the supply of houses with water at a very small cost.

SUBMARINE FOUNDATIONS.

Dr. Pott has patented an important invention for constructing Submarine Foundations for Breakwaters, Lighthouses, Batteries, &c. The leading character of Dr. Pott's invention consists in atmospheric pressure being allowed to exert itself upon a surface, under which a partial vacuum is being created. He proposes to accomplish this by making the piles hollow, and, in some cases, covering them at the top with an air-tight cap. The pile, whether of iron or wood, is in this state placed upon the soil in the direction in which it is to be driven. A reservoir is placed at low water-mark, and communicates, by means of a large hose or metallic pipe, with the head of the pile about to be driven. This reservoir is in communication with apparatus for the exhaustion of air, consisting either of air pumps or steam condensers. Water is supplied to the soil immediately under the pile by the same engine. The effect produced by this contrivance is to keep the subsoil in a state of agitation, and hold it mechanically suspended. When the air in the pile becomes a little rarefied by the action of the exhausting machine, this mixture will rise, and ultimately pass through the pile-head into the receiver. This vessel being filled, a cock or valve at the bottom is turned, and its contents are discharged: the operation may be resumed any number of times, by alternately closing the valve, pumping the soil into the receiver, and discharging it. The soil thus pumped up does not come from the outside of the pile. When any portion of it is raised, atmospheric pressure. and the weight of the pile, act instantaneously with joint forces, thus shutting out the adjacent soil by the sinking of the pile. All that comes up is brought from below the interior of the pile, which will therefore continue to descend till lateral pressure overcomes that of the atmosphere, added to the effect of gravitation. In some soils, the inventor, when sinking a large pile, does not use the cap, but sends down a man with a flexible tube in connection with the exhauster. This tube being directed to various parts of the base of the pile, its foundation is undermined by the removal of the soil, and the pile will sink till it be necessary to resort to more extensive exhaustion. In all these cases the estimate of the weight which the piles could sustain is afforded by the known pressure of the atmosphere. This is fifteen pounds on each square inch, at an average height of the barometer, but it will be considerably diminished from the imperfect rarefaction capable of being attained by even good machinery. It may be said that 1,000 lbs. will be about the extent of atmospheric pressure thus brought into play, and it is true in the case of ordinarily-sized piles. With this force, however. small as it is, the effect would be produced; for the principal resistance is removed by the pumping out of the sand. Dr. Potts applies these means to the sinking of caissons, for the purpose of constructing an isolated rock, on which a lighthouse might be built. The caisson is made of the proper size, and the annulus, or hollow ring, divided into several compartments, or air-chambers. It may then be floated to its place, and sunk

by the admission of water into its chambers. The means we have described may then be employed till an enormous pressure would be requisite to sink it further. Piles, &c. having been sunk by these means to their proper depth an actual rocky structure is to be formed about them, by the application of cements described in the patent: among which Roman cement, and Medway burnt up with lime, are of the number. The bottoms of the piles are inclined, and the horizontal reaction thus obtained forces them more closely together.

MECHANICAL FORCE OF THE CATARACT OF NIAGARA.

WHEN it is considered that the water-power of the Cataract of Niagara is unceasing by night as by day, and that the power for practical purposes in Great Britain is only applied, on an average, about eleven hours per day during six days of the week, it may be assumed that the motive power of Niagara Falls is at least forty-fold of the aggregate of all the water and steam power employed in Great Britain, and probably equal to the aggregate of all the motive power employed for mechanical purposes on this earth. The surface of Lake Erie is found to be 331 feet above the surface of Lake Ontario, and 565 feet above that of the ocean. The descent of the waters of Niagara River, in the few miles of distance between Black Rock and Queenston, is about 171 feet, exclusive of the grand cataract itself, forming a succession of rapids which, in some places. present to view the sublime spectacle of the agitated surface of the ocean in a storm; and these rapids continue to occur during the subsequent descent of the river St. Lawrence, from the level of Lake Ontario to that of the sea, making, in the aggregate, above three-fold of the waterfall of the grand cataract, and consequently one hundred and twenty-fold of all the physical power derived from the use of all the waterfalls and steam-engines employed, as above stated, in Great Britain, omitting to take into account the several huge rivers that are tributaries of the St. Lawrence. Such, and on so great a scale, are the ordinary operations of the impulses of physical power employed in the "mechanics of nature" in governing the movements of the waters of a single river, exceeding manifold the portion of physical forces rendered available and employed by all the inhabitants of the earth as a motive power in the "mechanics of the arts."—*American Journal of Science and Art.*

CHEAP AND PORTABLE SELF-REGISTER TIDE-GAUGE.

THIS is a very beautiful, simple, cheap, and portable Tide-Gauge, invented by Mr. J. Wood, of Port-Glasgow. It can be packed in a box of about two feet square, costs about £2 only, and registers by a pencil on a cylinder of paper the total rise and fall of the tide for a month at a time. By a simple addition, costing only 20s. more, where there is a clock at hand, it can be made to register the state of the tide at every period of time. The machine has been much admired for its simplicity and cheapness.

EDGE'S WATER-METER.

THE Meter consists of a rectangular box, fourteen inches long, thirteen inches wide, and twelve inches high, divided into two chambers by a partition, in the top of which is an aperture, which forms a communication between the two chambers: a four-way cock is fixed in the partition, the larger end of which opens into one chamber, and the smaller end into the other; the water is conducted to and from this cock by means of tubes passing through one of the chambers; parallel with the centre of the cock is a spindle working in upright standards. The spindle carries a driver, which acts upon projections on the play of the cock, and also carries a metal cylinder hermetically sealed, in which is a heavy ball, less in diameter than the cylinder itself, so that it may freely roll within it. In the upper part of one of the chambers there is a float working upon an axis which carries a pendant arm, having upon its end a friction pulley. As the float rises and falls by the action of the water, the arm vibrates, and acting alternately on the inner sides of two teeth of the spindle, causes the lower end of the cylinder to be raised, and thus the ball rolls to the opposite end of the cylinder, which, by its weight, moves the spindle suddenly round, and causes a change of inlet and outlet by the motion communicated to the plug of the cock: upon the axis are two teeth working into a crown-wheel, so that the vibration of the axis gives rotatory motion to the upright spindle, which is connected with a counting apparatus, also of an improved description.

ADVANTAGES OF FRAMEWORK OF MALLEABLE IRON FOR JETTIES AND BREAKWATERS.

CAPTAIN VETCH, R.E., F.R.S., advocates the theory, first propounded (we believe) by Lieut.-Colonel H. Jones, R.E., that piers and breakwaters having long slopes towards the sea, are the most liable to destruction, while those approaching the perpendicular are the least so. And on this basis he builds the plan described in the paper, of which a sufficiently clear idea may be formed from the following brief extract:—

"The mode of construction upon this project consists essentially in the application of upright rods of malleable iron, steadied and fixed in their places by passing them through apertures in two parallel and horizontal frames of flat iron, provided with corresponding orifices to receive them; the lower frames being placed about three feet above the low-water mark, and the upper frame about three feet above the high-water mark, or at such other convenient distances apart as the circumstances of the case may demand. The horizontal frames may be conveniently constructed in short lengths, say of four feet each, and an additional piece of frame may be connected with the preceding one by round bolts passing through loops, forming so many moveable joints, that the frames may be the more easily raised, lowered, or adjusted to the required level, if from the settlement of the upright rods they have swerved from their original horizontal position. The new lengths of frames having been bolted to the preceding ones, and

tained in a horizontal position by diagonal stays, are ready to receive the upright rods, which are then to be dropped separately through the corresponding apertures of the frames, and each allowed to take its bearing separately by its own gravity, or by such farther pressure as may be deemed proper. When the rods have taken their bearing and settlement, a row of sloping rods have to be added to each side of the jetty, inclining inwards one foot in ten or twelve, to give lateral support; and at this state of the operation it is proposed to key on to the rods the iron collars for the permanent support of the horizontal frames and the platform."

Captain Vetch estimates that the expense per lineal yard of a breakwater of this description would be 148*l.* 13*s.* 8*d.*, while the Plymouth Breakwater cost about 1000*l.* per lineal yard, and the harbours of refuge, which it is in contemplation to erect on the coast of Kent, have been estimated to cost 660*l.* There would also be an immense saving in time.

"The Plymouth Breakwater took twenty-eight years to complete, and it is understood fourteen years has been estimated as the required time for the harbour of refuge at Dover; now, in the construction by iron framing, it is reasonable to assume that a frame of four feet may be set each tide, and by working from two ends, sixteen feet per diem ought to be performed in good weather; the length of sea face of the proposed harbours of refuge average 9100 feet, so that 569 days would be required to complete the iron framing for one, and allowing for Sundays and bad weather, the work would be accomplished in less than three years, say in one-fifth of the time estimated for the Dover harbour, on the principle of construction of the breakwater in Plymouth Sound."—*Weale's Quarterly Papers*, Part 2. Vol. I.

ON IRON WATER-TIGHT BULKHEADS.*

BY C. W. WILLIAMS, ESQ., LIVERPOOL.

A DESIRE to lessen or prevent those accidents to which ships are liable at sea, has long engaged the labours and attention of humane and scientific men; and when we consider the fragile nature of a ship, as compared with the tremendous force of the sea, and that a single plank is all that is interposed between that element and those on board, we are tempted to express our astonishment, not that so few vessels are lost, but that so many escape.

The casualties to which ships, particularly steam-ships, are liable, arise, for the most part—first, from striking against or coming in forcible contact with rocks, or such solid bodies as would injure the frame-work of the vessel; and, secondly, from accidental collision with other vessels, by which some part of one or both vessels becomes so damaged as to admit the water to such an extent as to overcome the power of the crews to pump it out.

Ingenious men have endeavoured to devise expedients for lessening the risk consequent on such damage. Among these was the introduc-

* From the Parliamentary Report on Steam Vessels.

tion of air-tight tubes to such an extent as, in case of the body of the vessel being filled with water, should give it so large a buoyant power as to keep the vessel afloat. A patent was obtained for this invention, and an ingenious tract published, demonstrating the protection which a given number of tubes, distributed throughout the vessel, would afford. It does not appear, however, that the practicability of stowing away a sufficient quantity of those tubes or air vessels was ever tested, or that a vessel of any magnitude was so fitted as to demonstrate its utility.

That any expedient shall be discovered which will prevent the irruption of the water to an extent beyond what may be in the power of men and pumps to expel, is a hopeless case. Even in the event of running on an anchor or other body, which should break any part of the ship's bottom or side, or of a single plank starting, the extent of the injury would most likely be such as to render it impossible to keep the vessel afloat by human power. It occurred to me, that the only practicable expedient for preventing the sinking or actual submersion of the entire vessel, would be, by confining the effect of the injury sustained to that portion or section of the vessel in which the injury occurred; and this is the basis of the plan I am now to submit.

Hitherto, nothing has been attempted which could prevent the water, in case of its breaking in, from collision or other causes, from passing at once throughout the entire body of the vessel; and here lies the great source of danger, particularly in steam vessels, as the fires being at the lowest part of the hull, are soonest affected by the water; and the chances of escape, by being expeditiously run on shore, are thus lost. Indeed, in steam vessels the mere circumstance of derangement to any of those pipes, or connexion between the interior or exterior, for the necessary introduction and expulsion of water from the engine and boiler, have often caused the most serious results. In one instance, the casual introduction of a piece of seaweed under the valve of the bilge-water-pump of a steam-vessel caused it to fill nearly to sinking. But when it is considered that those casualties, which too often occasion the sinking of a steamer, are local in their origin, and affect but a small portion of the vessel, and that the water admitted is often of so small an extent as to be almost within the power of the pumps, it will at once suggest the importance and the efficiency of the protection, by confining the water to that section of the vessel which has sustained the injury.

The plan of dividing the vessel's hull into sections, each of which should be completely water-tight, has, we are told, been practised by the Chinese in their trade-barges, the several water-tight compartments being under lock and key, and appropriated to separate shippers.

This mode of giving security first occurred to me on building the iron steamer, the *Garryowen* (now plying on the Shannon at Limerick), and the trade barges which the Dublin Company's steamers tow on that river. Where the hull was of iron, as in the *Garryowen*,

the introduction of iron plate bulkheads was easy and effective; and, independently of the great strength afforded by this internal and sectional bridging, (as it may be called,) these sections were as susceptible of being made water-tight as the vessel itself.

Experience has proved that it is impossible to make a timber partition or bulkhead water-tight, or at least that it should continue so. The heat of the vessel is sufficient to cause such a shrinking in a partition of timber planking, as to render it wholly useless in preventing water from passing. Iron plate partitions, however, possess all the requisites for this effectual division of the vessel into so many water-tight compartments. Their introduction into timber-built ships appeared, then, an important desideratum. Many objections, however, were started. Men do not like to be put out of their way; and, indeed, a plan which should prevent ships foundering at sea was, at least, not likely to find much favour in the eyes of shipbuilders.

The only parts, where water could pass from any one section, when filled, to another section not so filled, would be, not through the iron partitions, but at the sides and bottom of the vessel, where they came in connexion with the frame and planking of the vessel. The preventing the water from passing in this direction is effected by very simple means, viz., by making this part of the vessel solid, that is, without those rooms or spaces which intervene between the frames of the vessel. This solid framing should extend to 18 inches before and after each partition. The mode of effecting this is familiar to all shipbuilders. The introduction of hairfelt between this solid framing and the planking on the outside, and the ceiling on the inside, completes the operation; the plate iron forming the partition having proper diagonal stays to give it strength, and being connected at the sides and bottoms with angle iron, accurately fitted to the shape of the vessel, particularly in passing over the kelsons.

The practicability of making these water-tight iron bulkheads being established, the next consideration was, the number that would be required, and their most eligible position. A *prima facie* view of the case would suggest the greatest possible number of divisions; certainly, the more numerous the partitions are, the more complete would be the protection afforded, and the more the risk of foundering diminished. The only considerations which restrict their number are, 1st, the inconvenience they create by preventing free access from one part of the vessel to the other under deck, the access to each being then, necessarily, from deck. 2ndly, the weight of these iron bulkheads, and the additional timber required to make the vessel solid at the place of junction. 3rd, the expense.

In considering the number and situation of these bulkheads, I will examine the advantages and disadvantages of each.

[Mr. Williams then describes in detail the relative value of one, two, three, or four bulkheads or partitions, and finally comes to this conclusion :]—

We come next to the division of the vessel into five sections, by means of four bulkheads. This arrangement I consider wholly unex-

ceptionable. Besides, this division fell so well in with the business of the several parts of the vessel as to give it at once precedence. The centre section would then be occupied by the engine, boiler, and coal-bunkers; thus detaching them entirely from all other parts of the vessel. The sections, Nos. 2 and 4, would be the fore and after holds, or, in case of passengers' vessels, the fore and after cabins; and the two remaining sections, at the bow and stern, need not be as high as the main-deck, as the water never could rise within several feet of the same.

Here, then, we provide an effectual remedy against the casualties attending on a vessel coming into collision with another. It may safely be said, that unless the water break into the vessel in all its sections at the same time (and which may be considered impossible), there can be no danger of submersion: and experience has proved, that a very small addition of buoyancy would prevent a vessel from sinking after it had been so immersed that the deck was on a level with the surface of the sea. Now, this improvement in the construction of steamers is not brought forward as an ingenious theory, or a matter of unascertained efficiency; I merely submit, for general information, what in practice is adopted by the Dublin Company at this moment in all their lately constructed steam vessels, to give security to the public, and protect their own property from casualty or loss.

The model (furnished with partitions on the plan recommended) is illustrative of what may be seen in several of their vessels now at work: the *Garryowen*, the *City of Limerick*, the *Athlone*, and the *Royal William;* and also in five other vessels recently built by the Company, the *Royal Adelaide*, the *Queen Victoria*, the *Duchess of Kent*, the *Prince*, and the *Princess*. To these he has since added the *Hindostan*, the *Bentinck*, the *Iron Duke*, and the *Lady Burgoyne*.

For testing the efficiency of these bulkheads, and that I might assure the members of the British Association, when in Liverpool, of their having stood the necessary proof, and being practically as efficient as they were satisfactory in theory, I caused the plan to be experimentally tested in the new vessel, the *Royal Adelaide*, for the inspection of the members of the Association. I first caused this vessel to be bored, and the water to flow freely into section 1, at the bow end. When so filled that the water remained at the same level outside and inside the section, it depressed the vessel six inches at the bow, raising the stern about two inches. Having the water pumped out, I then had the next bow section filled (No. 2). This depressed the bow twelve inches, without perceptibly raising the stern end. The vessel was then in the situation of one in which collision had taken place. For accuracy sake, I here state that the bow and stern sections are each 16 feet long; the two next, 35 feet long each; and the centre, or engine section, 58 feet—making in the whole, 160 feet.

The fact of buoyancy, then, not admitting of a doubt, the whole question of efficiency turns on the practicability of making those bulkheads water-tight; this, then, has been tested in so satisfactory a

manner that I do not hesitate to affirm that had the *Apollo*, the vessel run into and sunk by the *Monarch* on the Thames; or the Bristol packet, the *Albion*, run on the rocks in Jack's Sound, near Milford, and many other steam vessels, been appointed with those water-tight iron partitions, no risk of life would have occurred, and the vessels would have remained afloat.

With respect to the additional weight and expense of these iron bulkheads, I would observe that, compared with their importance and the security they afford, they are comparatively insignificant. The bulkheads on board the *Royal William* and the *Athlone* cost £290 each vessel, and the additional timber required in the solid framing must be trifling.

Considering, then, how deeply the public are interested in the progress and improvement of steam navigation, and the rapid strides it is making in all parts of the world, and the multiplication of the risks of collision consequent on that increase, it cannot be doubted that it is a legitimate object for the interference of parliament. Can any rational or humane mind contemplate the consequences of a collision between two vessels, and the loss of life that may ensue, and not admit that they who build a vessel hereafter, and neglect such precautions, undertake a responsibility of the most awful nature? Had I the power I would enforce this protection by law. All vessels, especially such as shall hereafter be built expressly for the conveyance of passengers, should have a license, granted on inspection and before registration, certifying the insertion of those or other equivalent preventatives against sinking.

[It is scarcely necessary to add, that had the precaution been taken of having this recommendation of Mr. Williams adopted, the following steam vessels would have been preserved, viz:—The *Iris*, the *Columbia*, the *Solway*, and the *Memnon*.]—*Mechanics' Magazine*, No. 1066.

TEMPORARY DIVING-BELL.

Captain Dickinson has received the Gold Isis Medal from the Society of Arts, for the following invention employed in the wreck of H. M. S. Thetis.

The ship, after striking, drifted into a cove about 100 fathoms inwards from the sea, and 90 fathoms broad, and surrounded by rugged and almost perpendicular cliffs, varying from 80 to 194 feet in height, where she sank with all her treasure.

Captain Dickinson, who had at that time the command of H. M. S. *Lightning*, submitted to Admiral Baker, then commander-in chief of the South American Station, his plan for the recovery of the treasure; but not being able to procure a diving-bell at Rio de Janeiro, nor the means of casting one, it occurred to him that it was possible to make such a machine of iron water-tanks, strengthened with bars of iron, &c.; and he obtained the Admiral's order to be furnished with two two-ton tanks from the *Warspite* (flag-ship). He next had an air-pump constructed under his own directions by an English mechanic, but being unable to find a workman at Rio who would undertake to

make an air-tight hose, he recollected that there was Truscott's pump on board the *Lightning*, and he succeeded in rendering the hoses belonging to it fit for the purpose of the air-pump by beating them hard with a broad-faced hammer, to render the texture as close as possible, then giving them a good coat of Stockholm tar, afterwards binding them with new canvas saturated with the same material, and, finally, winding them round tightly with new and well-twisted yarns. These were used throughout the whole of the operations, which lasted upwards of a year, and answered extremely well, only requiring occasional repair. A more powerful air-pump was also constructed by Captain Dickinson, by making a trifling alteration in the force-pump of Fisher's watering apparatus, which he obtained from on board the *Warspite*, by application to the Admiral.

The first diving-bell used in the operations was constructed in the following manner:—One side of a two-ton tank (4 feet square) was taken out, another was divided into halves, from one of which halves the side was also taken out, and it was then securely joined to the bottom of the former by rivetting and caulking; thus forming a cubical vessel, 6 feet in height, by 4 feet in breadth each way, and open at the bottom. Round the upper square of the head, bars of iron, two inches broad and a quarter of an inch thick, were riveted, and others were placed down each side of the corners, from the head to the lower edge, which was also strengthened in the same way as the head. In the inside, at the upper corners, were diagonal bars to afford additional support against the pressure of water when the bell was suspended. Slings, made of the *Lightning's* top-chain, with shackles, were attached at each corner of the head, and the other extremities were united at the point of suspension by a chain-cable shackle. For the purpose of weighting the bell, three loops of bar-iron were placed on each side of the lower half, through which a sufficient quantity of chain-cable was rove, with the addition of four large pigs of ballast, one fixed in each corner, in the inside, to sink it. At 18 inches from the lower edge in the inside, were two bars of iron, to answer the double purpose of strengthening the bell, and supporting two seats for the men to sit on; and across the centre of the bottom, at the extreme lower edge, was a flat bar of iron to rest the feet on, which was removeable at pleasure, to be put out of the way when the bell was at the bottom, so as not to obstruct their work. On the upper part, in the inside, were numerous hooks, for the purpose of suspending the various implements for boring rocks, digging, &c. It was lighted by six patent illuminators, two on the top, and one on each side. When weighted, it weighed about four tons, but it was afterwards made considerably lighter.

This bell was worked from a davit or crane fixed in the stern of a launch, which was a service of great labour and danger, the violent surging of the boat with the top weight of the bell on the davit frequently endangering its being swamped; and in order to remedy this danger, Captain Dickinson greatly improved the bells subsequently constructed, by loading them with pigs of ballast only, placed within

an iron frame, and merely wedged in, so that, in the event of the wind suddenly changing, they could be easily removed, and the bell be rendered so light that it could be shifted in a few minutes, by a small tackle from the davit to the centre of the launch, the top weight being thus relieved, and the ballast available for the boat.

While the bell was worked in this manner, the advantage of wrought-iron material was made manifest, the bell frequently oscillating to the extent of 10 or 12 feet; and it is more than probable, that, under the same circumstances, a cast-iron bell would have been split, and the lives of the men lost.

In consequence of the labour and danger of towing the launch, at the close of each day's work, nearly a mile along the coast, and through a narrow strait, subject to violent currents into the still water of a bay, on the beach of which the crew of the *Lightning* were encamped, Captain Dickinson devised the construction of a derrick, of 158 feet in length, made up of twenty-two separate pieces of spars recovered from the wreck of the *Thetis*. The derrick was stepped in an excavation in the rock within the cove, a few feet above the water's edge, and supported at its head by a cable made fast to the rocks above, at the height of 150 feet, with various other stays, whereby the outer end of the derrick was raised to the height of about 40 feet above the sea. The summit of the cliff was levelled, and holes were worked in the granite wherein capstans and crabs were fixed; the crabs having been formed out of the stumps of the topmasts saved from the wreck. A stage was suspended from the derrick, from which a diving-bell, larger than the others, but of a similar construction, was successfully worked. By all the contrivances, in which Captain Dickinson displayed consummate professional skill and ingenuity, turning all his disposable materials to account, and meeting each difficulty as it arose, no less than $\frac{15}{16}$ths of the treasure, and a large quantity of government stores, were recovered.—*Transactions of the Society of Arts*, Vol. liv.

CAST-IRON LIGHT-HOUSE FOR THE WEST INDIES.

We quote from the *Illustrated London News* the annexed details of a Light-house of novel material and construction, by Messrs. Cotten and Hallen, the engineers and iron founders.

The tower is constructed of cast-iron concentric plates, and it is intended, when permanently fixed, for a light-house on the sea shore of the island of Bermuda, in the West Indies.

The extreme height of the whole, from the base to the ball on the top of the lantern, will be, when completed, about 130 feet. The outside diameter of the base is 24 feet, tapering upwards to 10 feet, and then springing out to a diameter of 20 feet; so as to form the platform, round the edge of which is fastened a palisade railing. On this platform will be placed the lamp-room, a polygon of 16 sides and about 15 feet diameter.

The tower is divided into seven floors, exclusive of the platform or gallery. The communication between the base and the first floor, about 20 feet from the ground, is by a spiral staircase, winding round

the column in the centre. The space between the staircase and outer plates forming the tower, will be a solid mass of brickwork and concrete.

At this floor, the interior brick casing is reduced to a thickness of 18 inches, and is carried up in a perpendicular line, leaving a circular room of 18 feet in diameter. The spiral staircase is then carried round the interior circumference of this floor to the second floor, which has likewise a casing of brick. The spiral staircases then pass from floor to floor in the same manner, until they reach the interior of the lamp-room.

The whole structure is lighted by 36 port-holes, each fitted with a pane of strong plate glass in the centre, and attached to the shell of the tower by hinges.

The tower is formed of 135 plates; the base plates have a surface of about 56 square feet; the plates decrease in proportion to the cone; each plate has a flanch or edge projecting inwards: the screws and nuts hold the plates together, and the hollow space between the flanches is filled with iron cement, and forms a perfectly air and water-tight joint.

The three upper floors following those cased with brick have an interior casing of wrought-iron, with an air space between the plates forming the tower, and the casing with mouldings and pilasters of oak.

In considering the many useful purposes to which iron is now applied, there is not one that can be more beneficial than its application to the construction of light-houses. How many of the colonies of Great Britain are surrounded by dangerous reefs and rocks, causing the destruction of numerous vessels yearly! Now these dangerous situations might be made comparatively safe by a light-house; and it is not generally known that a commodious and permanent structure of this kind can be made in England, and easily transported, at a comparatively trifling cost; whilst it will require little more foundation than levelling the spot on which it may be placed by a small number of men, and thus be constructed and set up within a few months.

SEVERN IMPROVEMENT.

THE Lincoln Lock and Weir being the first of the series connected with this important work, have been brought into full operation. The lock is 100 ft. long by 20 ft. wide, with a lift of 7 ft. at low water. The walls and invert are faced with blue Staffordshire bricks of excellent quality, and are built upon a foundation of red sandstone rock. The water is let in and discharged through a culvert 7 ft. high by 4 ft. 6 in. wide, built in one of the walls, and running parallel with the lock chamber, with which it communicates by seven arched openings: by this arrangement the lock is filled with such rapidity that vessels have been passed through it in 2½ minutes.

The weir, which is 300 ft. in length, is constructed of two rows of sheet piling, the waling of which forms the upper and lower sills, the intermediate space being filled with blocks of red sandstone; a large

quantity of this material is also placed below the lower sill to protect the piles from the action of the water. Both the lock and the weir are placed in artificial cuttings, which arrangement required the waters of the Severn to be diverted from their original course. From a variety of causes this was a work of no small labour and difficulty, but it was successfully performed, and the water was turned into its new channel over the weir on the 30th of December last.

Four other locks, one being 150 ft. long by 30 ft. wide, together with their accompanying weirs, which range from 300 to 400 ft. in length, are in course of construction between Stourport and Deglis, near Worcester. The works below Worcester consist of a series of embankments, and the deepening of the navigable channel by dredging. —*Civil Engineer and Architect's Journal*, Part 78.

GREAT FOUNTAIN AT CHATSWORTH.

THIS stupendous work, designed by Mr. Paxton, for the Duke of Devonshire, has been described to the Mechanical Section of the British Association. The fountain is supplied with water from a reservoir which covers 8 acres of land, and which receives the waters from the moors. One hundred thousand yards of earth have been cut away for this reservoir, and 2621 feet of piping, having 298 joints, have been constructed for conveying the water. The fall of the pipe is 381 feet, and the height to be attained by the water from the fountain is 280 feet, or about 60 feet beyond the highest point of York Minster. The description of this fountain was given as applicable to the study of hydrostatics, showing the friction of water upon pipes, the impediment to its free course by friction against the air. One gentleman observed, with reference to the force of water thus emitted, that the sensation produced by putting a finger in the pipe was just like that which would be experienced by putting a finger into the flame of a candle.—*Civil Engineer and Architect's Journal*, Part 86.

DEPTHS OF ARTESIAN WELLS.

THE perforations by which the Chinese obtain salt water are 1800 feet deep; but as the water does not of itself appear, they are scarcely Artesian. The seventh bed of water at St. Nicholas d'Aliermont is 1025 feet below the surface. As coals, not water, were the object of search, the works were abandoned, but the Artesian Well remained. A hole recently bored at Geneva did not reach water at 682 feet. At Suresne, near Paris, a hole 663 feet deep has been pierced; but no water flows. The fountain at Chiswick, belonging to the Duke of Northumberland, is 582 feet deep. The deepest fountain in the Pas-de-Calais is 461 feet. There is a well at Tours, 259 feet deep; and one at the silk manufactory of the Champoiseau, 273 feet. An Artesian fountain in the monastery of St. André, half a league from Aire, ascended 11 feet above the level, and produced two tons of water per minute. The Artesian well at Bajes, near Perpignan, gives 440 gallons per minute. The fountain at Tours gives 246; the well at Merton, in

Surrey, gives 198; that at Rivesaltes 176, and that at Lillers, 154 gallons. At Gouchem, near Bethune, the waters from four borings turn the millstones and churns, and serve for other purposes. At Saint-Pol, a mill is turned by similar means. At Fontes, near Aire, the water from ten borings turns some large millstones, and also works the bellows and hammers of a forge. All the machinery of the silk manufactory of M. Champoiseau at Tours, is kept in motion by water from a similar well. At Tooting, near London, the water from an Artesian fountain belonging to a druggist works a pump, by which water is forced three stories high in his house.—*Polytechnic Magazine.*

ARTESIAN WELL AT SOUTHAMPTON.

In 1837, the important subject of the supply of water was brought more particularly under the attention of the inhabitants of this town, and at the desire of some of the more spirited and scientific residents an experimental boring was made upon the common, at a distance of about two miles from the town, and at an elevated spot north of its site. This experiment indubitably proved that an unfailing supply of water could be procured in such unlimited quantity as, it was hoped, to be supplied to the inhabitants at a reasonable cost. In consequence, measures were immediately taken to sink a shaft. The works have now been in progress some years, and, as will be seen, the Artesian Well of Southampton is, though uncompleted, a work of the greatest magnitude, vieing with, if it does not surpass, the great well of Grenelle, by which Paris has lately been supplied. The depth of the Southampton well is 1300 feet. The shaft descends through 78 feet of alluvium, 300 feet of clay similar to the London clay (which is a general substratum in the Southampton basis), and through another 100 feet of plastic clay, before it reaches the chalk, through which it descends 100 feet still further. Thus from the surface a well has absolutely been built downwards nearly 570 feet, and under such difficulties, from irregularities in the strata, that four iron cylinders have been placed in points where no attempt at masonry could have proved successful. Not the least singular part of this work is the manner in which this underground well has been built from the summit level downwards "into the very bowels of the land." This is a matter, however, which it would be tedious to describe; suffice it, therefore, to say, that after reaching nearly 600 feet, the operations of the masons were suspended, and the boring-rods were brought into operation, and employed until, through their instrumentality, the contractors have reached a depth of 1300 feet. As might be expected, the supply of water is already abundant. It now rises to within 40 feet of the surface, and by the aid of powerful steam-engines, no less than 55,000 gallons a day are literally poured into the town of Southampton.—*Correspondent of the Times.*

NEW LIFE BOAT.

A new and ingenious Life-Boat has been built at Boulogne. It

can be put together and taken to pieces in an incredible short space of time, and if it strike the side of a vessel, a rock, or a pile, will bound off like a foot-ball, without any injury to itself; if designedly upset keel up, it will right itself, without any danger to the boatmen or passengers, who cannot be shaken out; and after acting as a pontoon, it can be converted into a comfortable tent for men or horses. The boat is made of cloth, waterproof, and imperishable, is of the whale-boat build, and ketch-rigged. The ribs or timbers, which run from gunwale to gunwale in a piece, are of white oak, and perfectly elastic, like bows. The ribs are served or corded in a manner sometimes used with coach springs, on the inside of which are thin laths of whalebone. This frame-work is covered, in place of a plank, with a peculiarly strong cloth or canvas, impenetrable to water. The deck is also of cloth, tightly laced to the gunwales, and laced through the centre, fore and aft, from the stem to stern-post; but the water is effectually excluded by laps or doublings. The oarsmen sit in thwarts, which are of cloth, through scuttles in the deck, from which coats are erected the same as the coats of a mast or pump; these are neatly fitted by plaits to their bodies, and buckle below the breast. A boat of 32 feet in length can save between 40 and 50 persons. When the boat is taken to pieces the keel can form the upper ledge of the roof of a tent, the walls being made of the cloth mentioned above, The inventor, Captain Cotter, has laid his invention before the French Board of Admiralty, where its merits are at present under examination, with a view to being reported on within a short period.

JEFFERY'S EMERGENCY BOAT.

MR. JEFFERY, the inventor of the marine glue, has shown, at the Woolwich Dockward, the facility with which that substance might be used in cases of shipwreck or dangers at sea; and in the construction of conveyances for men and ammunition, or other stores, across rivers when engaged in warfare. The experiments took place in the presence of Colonels Paterson, Lacy, and Turner, Brigade Major Cuppage, Captain Bullock, &c. &c. Mr. Jeffery and his assistants commenced operations by unfolding several pieces of wood about an inch thick, joined together with hinges, and appearing like a folding fire-screen. Several smaller pieces were then attached with hooks and eyes, and the composition applied to the joints, and in 20 minutes a boat 12 feet long, 4 feet broad, and 20 inches deep, was constructed and launched, having an air-tight space in the stern of 2½ cubic feet, and a similar air-tight space of 15 cubic feet in the fore part for rendering it buoyant. Immediately on its being launched, Lieutenant Nicholls, commanding the *Dwarf* steam vessel, Mr. Jeffery, and two workmen, went on board, and were rowed to the *Hebe* receiving vessel, stationed in the middle of the river, and returned on shore, the whole time from unpacking the pieces of wood to the end of the experiment only occupying about 35 minutes, and the vessel was taken on shore by two men without having leaked one drop of water. On being weighed at the machine it was found to be 2 cwt. 7 lbs. Mr.

Darling, from Devonport, who was sent from that dockyard to receive instructions in the application of the marine glue, superintended the construction of the boat; and although it was the first time the experiment was tried, it answered satisfactorily, and afforded evidence of the simplicity of the application of the substance, and the uses to which it might be made an important auxiliary in cases of emergency.—*Mechanics' Magazine*, No. 1065.

COBBOLD'S TUBULAR LIFE PRESERVER.

THIS simple and inexpensive apparatus is constructed of separate or detached air-cells or tubes, so arranged and adapted to the body as to render it incapable of sinking, and affording the greatest possible security to the swimmer. It may be instantaneously applied, giving perfect freedom to the limbs, and protecting the body from concussion against drift wreck, ice, or any other hard substance. It is greatly lighter and more durable than cork, and cannot, like that substance, become saturated with water, nor is it liable to be punctured or destroyed by friction, as is the case with all inflated and soft fabrics, being perfectly durable, and indestructible either by time or climate. It may be said, with perfect propriety, that no person who values his life should go to sea without this complete safeguard and protection.

This invaluable preservative has for some time been daily exhibited by the diver at the Polytechnic Institution with the greatest success.

The Tubular Life Preserver has also been satisfactorily tested by naval officers of the first distinction and experience at various seaports; among others, by Captain Bullock, R.N., at the port of Ramsgate, where four of his crew, in presence of numerous spectators, plunged overboard heavily clad, and were fully supported on the water by the aid of this simple apparatus, without the necessity of making the slightest exertion: the experiment elicited the marked approbation of the gallant officer.—*Polytechnic Review*, No. 5.

THE PATENT KAMPTULICON LIFE-BOAT.

LIEUT. WALTER, as well known for his mechanical ingenuity as for his skill in railway administration, has constructed this Life-Boat for the Patent Elastic Pavement Company, on the model of Mr. Greathead's celebrated boat, built in 1795. It is formed of planks of an extraordinary combination of ground cork and India-rubber, which possesses the following qualities.

1st. From the specific gravity of the planking being so much lighter than wood generally used in boat-building, the greatest possible buoyancy will be secured. 2d. From the elasticity and toughness of the stem and stern-posts, as well as planking, it will resist the severest blows. 3d. From its extreme natural buoyancy it will be capable of removing from a wreck a greater number of people than any other kind of boat; the ten air-boxes alone have a buoyancy equivalent to upwards of 7,800 lbs. 4th. From its lightness, and being easily mounted on a carriage, it can be moved with facility along the shore, either to windward or opposite a wreck; and has masts,

sails, and rudder, to use on special occasions, as well as twelve oars, and two steering oars. The following are the dimensions of the boat: the length, from end to end, is 34 feet; the breadth, 11½ feet outside the cork fender; the depth, 4 feet from the top of the gunwale to the upper part af the planking in midships; from the top of the gunwale to the flooring, 2 feet 1 inch; from the top of the stems (both ends being alike) to the horizontal line of the planking, 6 feet; from the ceiling to the top of the air-boxes, 15 inches; depth of keel, 2½ inches. The form of the boat narrows gradually towards the ends, forming a great convexity downwards. The stems are segments of circles, with considerable rakes. Air-tight boxes are secured under the thwarts in midships, for provisions and necessaries for persons in distress. The mode of building with this elastic planking is on framework. The planks being rolled out to the length and breadth required, were passed diagonally from the gunwale on one side to the gunwale on the other, so that there are no butt ends, the edges of the planks being glued together by a solution of India-rubber. The first and second courses of planks are half an inch each in thickness; on the outside of the second course of diagonal planking, is applied a coat of India-rubber solution, and a coat of canvas, saturated with the same preparation of India-rubber, resembling mummy-cloth, over which is placed the third longitudinal planking, of the thickness of three quarters of an inch, making in the whole thickness about one inch and seven-eighths. Before being copper-fastened throughout, the temporary supports were replaced by alternate ribs of oak and prepared India-rubber, so that should one of the oak timbers or ribs be broken by a violent blow, the India-rubber rib would support the fractured side, whilst it defies a similar casualty. And, lastly, life-lines, about ten inches in height from the gunwale, extend along the whole length of the midships, about twenty feet. On Nov. 7, 1844, the boat was launched, and, with upwards of twenty-five persons on board, was found to draw only fifteen inches of water, and fully answered every expectation entertained of her.

AN IRON LIFE-BOAT.

This Boat has been built at Havre, by subscription, and was submitted to trial in the presence of a committee appointed for the purpose, who declared it to be perfect; consequently, it is now placed at the port for service, in case of need. It is built of cast-iron sheets, is 26 feet 3 inches in length, and 5 feet 3 inches in breadth. The reservoir of air is divided into three compartments, perfectly distinct from each other, so that any accident happening to one of them would not destroy its buoyancy. Self-acting valves let in or out such quantities of air as may be required to preserve its equilibrium, according to the weight with which it may be charged, and, by means of a water-proof cloth, so arranged as not to confine the motions of the rowers, excludes the possibility of its being swamped by shipping water.

SAFETY BUOYS.

John Wood, Parkfield, Chester, merchant, has patented the following Improvements in Machinery for giving additional Buoyancy to Sea-going Vessels, &c. Their novelty is confined to the mode of applying elastic substances inflated with air for the purpose of giving buoyancy to ships in cases of springing a leak, or when it is required to raise part of the vessel out of water for the purposes of repair. The patentee proposes to make the buoys of India-rubber, either spherical or cylindrical, each one to be from fourteen to twenty feet in diameter. The India-rubber is to be covered with a strong canvas case, and to be further protected by a net-work of strong cordage. These buoys, when not in use, are to be rolled up and kept on deck in a state of readiness, and each one has tackle fitted to it to enable it to be drawn under the ship. An elastic tube is attached to the India-rubber, through which it may be inflated by the sailors on deck, either by means of a pair of bellows, or an air-pump. The specification describes various methods by which the buoys may be applied according to circumstances; among which are included the application of similar buoys internally as well as externally, so that they may be always ready to be inflated in case of accident. It is further proposed to apply the same principle to the lifting of weights on land, by means of an instrument like a pair of bellows, into which air is to be forced, and the weight lifted by its compression. The patentee also intends to apply the buoyancy of air in the construction of iron bridges; the whole structure being floated by air-chambers at the bottom of the piers, and moved to the bed of the river to keep it from being carried away. From the tops of these floating piers the chains may be suspended whereon to rest the roadway of the bridge.

THE TOPOSCOPE,

A curious instrument, the invention of M. Schwilgué, (the mechanist of the far-famed clock of Strasburg cathedral), is about to be established on the platform of the same edifice; its object being to determine, during the night, the true position of lighted objects in the distance, false impressions on the subject being often of disastrous effect; as, for example, in the case of conflagration. The apparatus in question, to which the inventor has given the name of Toposcope, is composed, according to the description, of two graduated circles, with subdivisions marked by an infinity of numbers. These circles, by their rotatory movement in inverse directions, furnish a multitude of numerical combinations. A telescope, moving with the upper circle, is fitted to the apparatus; and, on directing this to the place of the disaster, the instrument itself furnishes, in measured numbers, its distance from Strasburg cathedral.

SIGNALS AND TELEGRAPHS.

On March 15, Mr. Cowper read to the Royal Institution a paper exhibiting the method of holding intercourse at a distance by means of conventional symbols, whether on land or at sea. The lecturer

distinguished *Telegraphs* (consisting of machinery more or less complicated) from *Signals*, which are simple constructions, as beacons, flags, &c. Having noticed the allusions to beacons by the sacred writers, many centuries before the Christian era, Mr. Cooper proceeded to describe the present improved state of the methods of distant communication. *Signals*: These comprise, 1st, the method, now brought to great perfection, of signalling letters, words, or entire sentences, &c., by means of a series of flags of different patterns, as used by the Royal Navy, or by merchant vessels; 2d, Homographs, or manual telegraphs, consisting of discs of basket-work, held in different positions, or, as is practised on railroads, the human arm extended in various attitudes; 3d, a plan, invented by Mr. Cowper's son, to give notice to the driver of a locomotive engine of his approach to a station, or an accident, in foggy weather: this consists of a small case of gunpowder, in which is inserted a kind of lucifer-match; this is fastened to the rail at the spot where the alarm is to be given, and as the wheel of the engine goes over it, it explodes, and the driver instantly shuts off the steam. The lecturer noticed that the explosion, though not loud when compared with the noise of the train, attracted attention by the difference of the sound. *Mechanical Telegraphs*: Mr. Cowper gave a history of these curious arrangements, beginning with the telegraph invented by Hook in the seventeenth century, and then proceeded to exhibit models, of the construction of Mr. R. L. Edgeworth, of the shuttle telegraph, used by the government for many years, till superseded by the invention of Sir H. Popham, the present Semaphore. This instrument was compared with the T telegraph, long used by the French. *Electrical Telegraphs*: Mr. Cowper concluded by exhibiting working models of the forms of these instruments, now used on the different railroads, and a magnetic electric machine, superseding the necessity of a galvanic battery; and lastly, a machine by Professor Wheatstone, for making the telegraph print on paper the message which it delivers.

THE TELEPHONE.

CAPTAIN JOHN TAYLOR has invented this powerful instrument for conveying signals during foggy weather, by sounds produced by means of compressed air forced through trumpets, audible at six miles distance. The four notes are played by opening the valves of the recipient, and the intensity of sound is proportioned to the compression of the internal air. The small-sized telephone instrument, which is portable, was tried on the river, and the signal notes were distinctly heard four miles off.—The instrument is engraved in a late number of the *Illustrated London News*.

NEW SOUNDING APPARATUS.

MR. LAIGNEL has submitted to the Academy of Sciences, at Paris, a notice of a new Apparatus for Soundings at Sea during the passage of a vessel through the water. At present it frequently happens, when a vessel is going at a quick rate, that the lead ceases to descend, and

even returns towards the surface. By the new apparatus, the line is made to fall by the progress of the vessel, on the same principle, in the inverse way, as a kite rises by the apparent action of drawing it towards the holder of the string. A disk of wood, to which the lead is attached, is made by the action of the apparatus in the resistance that it sustains to plunge towards the bottom.

PERCUSSION AND CONCUSSION SHELLS.

SOME experiments of a highly interesting nature have taken place in the port of Brest. A few Percussion Balls were tried, after having been laid by several years, in order to ascertain whether, after a prolonged exposure to the marine atmosphere, the permanent humidity of the shores was not capable of injuring them, inasmuch as it generally happens that the fusees of ordinary shells are completely useless for service after the expiration of one year. The results were highly satisfactory, and left no doubt as to the perfect conservation of the new projectiles. M. le Commandant Billette has adapted his system of percussion to hollow balls or shells destined for carronades of 30, 24, and 18; and thus, all our cannons will henceforth be capable of expelling explosive projectiles. With the powerful destructive agents now in our power, battles will be of a short duration, and victory will be obtained by the ship which shall first succeed in sending on board her adversary a small number of these explosive shells. But victory or defeat will be greatly decided by the accuracy of the aim, to which every attention should be paid. M. Billette has also proposed a new mode of firing pieces, more instantaneous than that now in use, and capable of affording the most accurate aim. If the hopes of the inventor are realized, a great step will have been gained in the science of naval gunnery; in fine, the problem of instantaneous ignition will be solved.

The British Government has since carried on an extensive series with Concussion Shells at Portsmouth. The Swiftsure, an old hulk of 74 guns, has been anchored at 1600 yards as a mark; the shells of Captain Norton have been fired first; the first day's experiments were very successful, a number of shells struck the vessel, and inflicted considerable damage; the next day, the same shells, fired from the same guns, were very successful, and since then the results have shown every possible variety—some have exploded on striking the water, while others have withstood that blow; some have exploded in the air from the shock of firing, while others have not exploded at all; shewing that a combination of circumstances is required for the certainty of these shells, even when recently prepared, and that as one or other of these are wanting, the explosion at the mouth of the gun, or their non-explosion, occurs. This shows how far even the most successful of the inventors are from having attained the perfection which the Concussion Shells of the French Government afforded: they answered perfectly, till they had been submitted to the test of exposure to the damp air of the sea-coast; it was then found that they were unserviceable, scarcely one answering, while those fitted upon the percussion principle had

sustained no change. The second day's experiments with Captain Norton's being so unfavourable, after the success of the first, would show that even twenty-four hours' exposure exerted a deleterious action on them. The reporter details the destructive effect of these shells as peculiarly terrific; but for this they are not intended, nor indeed could they have any advantage over the shell of the service; they are made of the same iron, of exactly the same thickness, and charged with the same weight of powder. The plan of loading shells with nails and old pieces of iron has been long since abandoned; the powder was mixed with them, and could therefore exert but a very slight force on them as projectiles; but the iron case of the shell, about one inch and a quarter thick, being broken into numerous jagged pieces, and thrown thirty or forty yards, inflicts most formidable wounds; the advantage to be derived from the concussion is from the burning fusee being driven by the blow into the shell, instead of, as now, burning into it. This, in the shells of Captain Norton, is effected by a small bar of fusible metal fastening the fusee: this metal, a compound of bismuth, lead, and tin, melts before the heat of the burning fusee, which becomes thus unconnected, and therefore drives in when the ball strikes; but, however beautiful the theory, in practice it unfortunately fails, and, when fired at short distances, the fusee is very often extinguished by the blow. Any shell bursting amidst crowded decks would cause great destruction, but that a vessel would be so injured by the explosion of a single shell as to sink, or to become unmanageable, is absurd.

Mr. Marsh, the Government chemist at Woolwich, has also invented a concussion shell, like that of Colonel Dansey, varying in some unimportant particulars from that of Captain Norton, to whom, or to Sergeant Ormerod, the credit of this suggestion should be given; but the impossibility of their ever being able to resist the sea air, and therefore to stand the sea-service, divests the experiments with these shells of much interest. The percussion shells recommended by the French Government have unluckily found supporters in the Duke of Normandy and Mr. Buckingham. Mr. Buckingham, assisted by Professor Ryan, performed some experiments at Wimbledon; his shells were by some peculiar principle to explode at given intervals, varying from a quarter of an hour to twenty-four hours, the blow from the explosion of the powder of the gun igniting some substance, which would burn slowly as touch-paper, and it was also stated that different points of ignition could be obtained by varying the position of the ball, which was surrounded with igniting points of different lengths.

Professor Ryan could have at once informed this gentleman that all such complicated powers would be useless to the service. During the hurry of an engagement, the sailors would be likely to vary the positions of the ball, and even if they could, under no circumstances would any other power than that of explosion by percussion be useful. The delay of the explosion would merely enable the party attacked to throw into the sea every shell as it struck. The sequel of these experiments was however tragic; one of the shells fired to explode at a

quarter of an hour, had remained without any apparent change for several hours. Professor Ryan had examined it, and had numbered it as having failed; a man named Taylor, on washing away the mud, probably shook the powder on the ignited particles, and the shell immediately exploded, maiming the poor fellow for life. Mr. Buckingham applied to the Police Office for assistance to recover the remaining shells, amounting to eight or ten, which had not exploded at the time appointed, and which even the horror of such an accident had not prevented from being dug up and used for knocking down nine-pins; one, to decide a bet, had been even put upon a fire. Government had no connexion, as stated, with this experiment; and it is a curious proof of Professor Ryan's absence of personal fear, to have superintended such dangerous experiments, as he must have remembered that a Russian General, two years back, lost his life from a shell, believed to have failed, exploding sixteen hours after firing.

Mr. Marsh's Concussion Shells have thimbles filled with meal powder, fastened with marine glue. He depends upon the heat of firing to melt the glue. This would appear at first view to be impracticable, but some experiments at Woolwich shewed a success equal to that of Captain Norton's. The Duke of Normandy has, he declares, the power of deciding whether his shell shall fire at the first or at the second blow. Now the second blow could never be required unless the Duke studied the interests of the enemy, who, using the shells fired against them, could avail themselves of the explosion at the second blow. This, however, was proved by a shell exploding by a weight falling on it. Now, whether the detonating cap was put on at the time agreed for firing, or, as was ingeniously suggested on the ground, at the blow agreed to fire it, the communicating passage was opened, is uncertain.—*Abridged from the Polytechnic Review*, No. 5 and 6.

SHELL AND ROCKET PRACTICE.

THE following very interesting experiments have taken place in the Woolwich Marshes, before a number of officers of the Royal Artillery. The experiments commenced by firing six 32-pounder shells from two pieces of ordnance, placed at 400 yards distance from the bulkhead, the object against which they were directed. The first shell entered the mound on the east side of the bulkhead, and exploded, tearing up the earth with great violence; and the second entered the mound nearly in the same place, and with a similar effect. The third shell went through the bulkhead, and entered the mound to a considerable distance before it exploded, which it then did, scattering a large quantity of earth in all directions. The fourth entered the mound and exploded nearly similar to the first and second. The fifth and sixth shells both entered the bulkhead, and went into the mound at the rear before they exploded nearly in a similar manner as in the experiment with the third shell. The inventor of the shells experimented with is a Mr. Buckingham, and they appear to be the best yet submitted to trial before the select committee, as they exploded in every instance at the time